DOCUMENT RESUME

ED 394 037 CE 071 394

AUTHOR	Llorente, Juan Carlos
TITLE	Problem Solving and Constitution of Knowledge at Work. Research Bulletin 92.
INSTITUTION	Helsinki Univ. (Finland). Dept. of Education.
REPORT NO	ISBN-951-45-7278-5; ISSN-0359-5749
PUB DATE	96
NOTE	281p.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC12 Plus Postage.
DESCRIPTORS	Adult Basic Education; Adult Education; *Adult Learning; Adult Literacy; Adults; Building Trades; Case Studies; Comparative Analysis; *Developmental Tasks; *Educationally Disadvantaged; Foreign Countries; Household Workers; Illiteracy; *Learning Processes; Learning Strategies; Models; *Piagetian Theory; *Problem Solving; Rural Areas; Task Analysis
IDENTIFIERS	*Argentina

ABSTRACT

A study examined the strategies and processes used by a sample of 33 Argentinean adults with little school experience to solve problems and acquire knowledge at work. A Piagetian methodological approach was used to observe adults in building, rural, and domestic work settings and to analyze empirical data regarding their behavior in task-oriented problem situations as a particular mode of knowledge constitution and their application of that knowledge in everyday work-related tasks. The constituents of the task-oriented situations studied were analyzed in relation to the social constraints emerging during the problem-solving procedure. The nature of cognitive activity in everyday situations was illustrated through case studies demonstrating the interactive and constructive nature of everyday knowledge. It was concluded that the processes by which individuals with relatively little education acquire knowledge are not very different from those used by educated people. An interpretive framework was presented for studying everyday activities as education-related issues. It was recommended that the potential of low-literate adults be used as a starting point for educational intervention. (Contains 135 references. Appended is information regarding the following: sample, work practices, study questions, latest interview, adults in the schooling situation, and interview profiles.) (MN)

****
*   Reproductions supplied by EDRS are the best that can be made   *
*   from the original document.   *
****

ED 394 037

DEPARTMENT OF EDUCATION
UNIVERSITY OF HELSINKI

RESEARCH BULLETIN 92

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

E. Niskanen

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Juan Carlos Llorente

PROBLEM SOLVING AND CONSTITUTION OF KNOWLEDGE AT WORK

CE071394

BEST COPY AVAILABLE

RESEARCH BULLETIN 92

Juan Carlos Llorente

PROBLEM SOLVING AND CONSTITUTION OF KNOWLEDGE AT WORK

Helsinki 1996

NORDIC ENVIRONMENTAL LABEL
411 011
Recyclable product with low
emissions during production

ISBN 951-45-7278-5

ISSN 0359-5749

Printed in Finland by Hakapaino Oy

Helsinki 1996

ABSTRACT

Problem Solving and Constitution of Knowledge at Work

Juan Carlos Llorente

The object of the study is problem solving and the constitution of knowledge at work by adults who have little school experience. The origin of the research is the inconsistency identified in *Educación Popular* in Argentina. The theoretical framework is Genetic Epistemology and Psychology (Piagetian theory). Discontinuities between the epistemological, psychological and pedagogical levels are analyzed for locating the object of study. Constructivism, interactionism and their explicative process of equilibration are examined as the central thesis of Piagetian theory.

I concentrate on three working contexts: a) building work, b) rural work and c) domestic work, the latter involving domestic help and housewives. Within each of these settings I have considered some specific practices for analysis e.g. the building of an octagonal corner, the pruning of fruit trees and the preparation of jam. I apply a Piagetian methodological approach in collecting and analysing the empirical data.

Therefore, I focus on task-oriented problem situations as a particular mode of knowledge constitution and the use of knowledge in carrying out everyday work-related tasks. Relevant cases are selected to show the use of knowledge and problem solving at work by illiterate adults.

When dealing with problem solving, my concern is specially in the characterization of problem situations, i.e by developing a theoretical interpretation of subjects' descriptions. I analyze the constituents of the task-oriented problem situations in relation to social constraints that emerge in the problem solving procedure. The constituents are the problem solver, the objective elements of a situation and the social context.

In relation to subjects' everyday knowledge, I am interested in observing knowledge constructed in particular work-related practices. Thus, I try to capture the nature of cognitive activity in everyday situations by showing the interactive and constructive character of everyday knowledge. The study supports the idea that formative processes of knowledge do not seem to be very different from those of educated people.

The study presents an interpretative framework for studying everyday activities as educational-related issues. Task-oriented problem situations and work routines are characterized by models which describe the interrelationships of the constituents and their relation to breaks in the work routine.

Finally, The study emphasizes the need to use the potential of illiterate adults as a starting point for educational intervention. Accordingly the everyday knowledge of adults could be utilized in different kinds of educational practices. Piagetian theory proves here to be a useful approach to understanding adults' cognitive processes at work.

Key words: Task-oriented problem situations, everyday knowledge, illiterate adults, work-related activities

ACKNOWLEDGEMENTS

I would like to start by acknowledging those persons who I have worked with in Argentina, the building workers, domestic workers and rural workers. My heartfelt thanks to Professor Alicia Lenzi, my former director in Buenos Aires.

I express my gratitude to the members of the Department of Education, the University of Helsinki where I found an extremely friendly environment in which to develop this study, otherwise this would have not been possible. My deeply felt thanks to all of them.

I would like to mention specially Professor Seppo Kontiainen and Associate Professor Kari E. Nurmi, my supervisors, who have warmly combined their personal commitment and academic experience in fostering the development of this study. I extend my gratitude to the members of the project Adult Learning and Cultural Context.

I want to acknowledge particularly Professor Jarkko Hautamäki who has acted as examiner in my Licentiate Thesis and Pre-examiner for this academic dissertation. My thanks to him for his permanent encouragement and comments on Piagetian interpretations.

I cordially thank Professor John A. Niemi from Northern Illinois University who acted as Examiner in my Licentiate Thesis for his comments and concern for my work.

Warm and deep thanks to Dr. Diana Coben from Goldsmiths College, University of London, who contributed as pre-examiner to the final stages of the study, for her illuminating comments. I also extend my thanks to Ms. Gillian Thumpston who kindly revised the English language in my thesis.

In the process of developing this thesis I have gone through various unforgettable exciting experiences linked with the venture of settling down in a different cultural context. As an Argentine friend of mine says, these experiences as a foreign student were altogether a parallel thesis. They have enriched me in many different ways and I have to thank all who have shared with me different moments during this intellectual and human adventure.

I must also mention the constant encouragement received from Mr. Pertti Mustonen as a Finn and friend. Special acknowledgement is extended to my comrade and friend Mr. Kari Kantasalmi who shared with me the day-to-day activities in our tiny smoke-filled office and long after work discussions. Sincere thanks also to a friend and colleague Mr. Tuomo Aalto who made possible the achievement of many important aspects of my thesis related to the presentation.

Finally, I gratefully acknowledge the financial support received during different stages of this study from *Universidad Nacional del Comahue* of Argentina; Centre for International Mobility (CIMO), Ministry of Education of Finland; Department of Education, the University of Helsinki and 350 Anniversary Fund, the University of Helsinki.

Helsinki, February 1996

Juan Carlos Llorente

TABLE OF CONTENTS

INTRODUCTION 5

1 - CONTEXT OF THE STUDY 15
1.1 *Educación popular* in Latin America 19
1.2 Dimensions of *Educación Popular* 24
1.3 Obstacles 29
1.4 Discontinuities 32
1.5 The research project 37
1.6 Adult education research and practice 39
1.7 Summary 42

2 - CONSTITUTION OF KNOWLEDGE 45
2.1 Is Piagetian theory epistemological, psychological or pedagogical? 47
2.2 Piaget's ideas in adult education 49
2.3 Epistemological-psychological interpretation 52
2.3.1 Epistemological level 56
2.3.2 Psychological level 66
2.3.3 The level of pedagogical interventions 76
2.4 Summary 83

3 - PROBLEM SOLVING 85
3.1 Interactions and conflicts 87
3.2 Conditions underlying problem situations 96
3.3 Different approaches 99
3.4 The role of conflicts 106
3.5 Summary 109

4 - METHODOLOGY 111
4.1 Piagetian clinical-critical exploration 111
4.2 Piagetian methodology in Adult Education 119
4.3 Sample 123
4.4 Description of the research process 125
4.5 The limitations and possibilities of the data 146
4.6 Summary 148

5 - TASK-ORIENTED PROBLEM SOLVING AT WORK 151
5.1 Building a model from the empirical evidence 154
5.2 Constituent elements of a problem situation 155
5.3 Routines at work 164
5.4 The constituents and the routine processes 169
5.5 Summary 174

6 - CONSTITUENTS OF A PROBLEM SITUATION 177
6.1 The problem solver 178
6.2 The objective elements of a situation (OES) 183
6.3 The social context 189
6.4 Summary 197

7 - THE USE OF KNOWLEDGE AT WORK 199
7.1 Housewives and domestic workers 202
7.2 Building workers 209
7.3 Rural workers 216
7.4 Summary 220

8 - RESULTS AND CONCLUSIONS 221
8.1 Everyday knowledge and literacy 222
8.2 Unifying dichotomies 224
8.3 Summing up results 228
8.4 General Conclusions 231

REFERENCES 235

APPENDICES 251
Appendix 1: Sample 252
Appendix 2: Work practices 257
Appendix 3: Questions by thematic block 261
Appendix 4: Latest interview 262
Appendix 5: Adults in the schooling situation 263
Appendix 6: Interview profiles 264

INTRODUCTION

Adult education research covers a wide range of fields and consequently it is difficult to make a clear picture of the situation. However, research on literacy and adult basic education can be identified as a particular area within adult education research. In countries of all stages at development, adult literacy is recognized as having a major status within overall adult education programmes. In some countries literacy related issues are matters of particular concern. In others countries with well established economies literacy forms a minor, though significant, part of adult education under different denominations like functional literacy.

In Latin America adult education is from its origins strongly linked with adult basic education due to the rates of illiteracy which characterize these societies. *Educación Popular*[1] is the most influential and powerful conception in adult education both at the theoretical and practical levels. Research related to *Educación Popular* has to take account of the fact that *Educación Popular* is founded upon a progressive conceptualization of practice. However, the hard reality which characterizes the development of *Educación Popular* has in some respects led to further development and in others obstructed its integral development. The principle of the growing conceptualization of practice has broken down under the strain of adverse socio-political conditions.

---

[1] I shall use throughout the text *Educación Popular* without translation into English. This is due to the variety of definitions of the term Popular Education. Other terms like education for freedom or liberal education, do not accurately fit the present meaning that *Educación Popular* has within Latin America.

The success of a literacy programme will be dependent to a certain degree on research undertaken to improve educational design through methods, materials and techniques. In this respect I see that research has helped to increase understanding of the political and historical dimensions and consequently of the role of education in the construction of society. However, little has been done in relation to the transference from theoretical postulates to practice, at least with respect to adult literacy.

Discontinuities in *Educación Popular*

Research programmes focused on methodological aspects of education or instructional design involve epistemological, psychological and pedagogical dimensions which are not always acknowledged. Nonetheless, these dimensions, either hidden or explicitly treated, constitute in my view, the basis for understanding contradictions in educational practices. Interpretative continuity among the epistemological, psychological and pedagogical level is crucial in the sense of theoretical-practical coherence.

Educational design is materialized not only in methods and techniques but in teaching-learning situations which comprise multiple factors. Teaching-learning situations can be seen in different ways by articulating or emphasizing the role of the intervening factors (teacher-centred, student-centred, the processes over the content or vice versa, individuals, group, and so forth). However in any case there are epistemological, psychological and pedagogical standpoints underlying the choice and consequently the situation. When these dimensions do not constitute a coherent unity it is difficult to anticipate results.

I find in *Educación Popular* an absence of continuity between these levels particularly when focusing on the pedagogical level. Piagetian Genetic Epistemology and Psychology offers a good theoretical starting point to address these discontinuities. In this study I use Piaget´s central theses to analyze theoretically and empirically the processes of problem solving and constitution of knowledge at work.

Studying everyday practices

In my view the search for continuities at the pedagogical level calls in the particular case of adult basic education for studies focused on everyday life. I have chosen the workplace of the subjects as the context for conducting the study, as I understand it includes relevant everyday practices related to the processes of knowledge constitution and problem solving.

In this respect, whole new areas of inquiry have emerged during the last 20 years. For example, there are studies with special emphases on everyday cognition (Rogoff & Lave, 1984; Cole & Scribner, 1974); cognition in practice (Lave, 1988); street mathematics[2] (Carraher, T. & Carraher, D. & Schliemann 1986; Saxe 1991). All these approaches have examined forms of social and psychological functioning that are explicitly contrasted with practices found in formal educational settings (Wertsch 1991, 111).

---

[2] The study of mathematics in everyday situations constitutes a growing area of research under different denominations: ethnomathematics, mathematics in practice, everyday mathematics, out-of-school mathematics and the like. All these denominations share the interest in gaining understanding of the processes of mathematical knowledge in relation to culture. However, analyses in every particular case stress different perspectives like anthropology, psychology, sociology as well as interdisciplinary approaches like activity theory.

Although much work has been developed to address problem-solving processes, it was mainly done to explain the developmental aspects of the knowing subject. Different research approaches were adopted (e.g. cross-cultural studies, situated learning, and so forth) based on different disciplines and different theoretical frameworks such as cognitive psychology, psychogenetic traditions, socio-historical approaches. However, a conceptualization of problem situations is still lacking. Studies on problem solving were mainly conducted to verify or study themes linked with psychological developmental aspects (Karmiloff-Smith 1984; Nunes & Schliemann & Carraher 1993; Schliemann 1988; Saxe 1991; Colinvaux & Dibar Ure 1989). That is, problem solving was used as a tool for studying other questions as if it were an unproblematic device. It is rare to find studies focused on problem solving itself. Consequently, a characterization of problem solving situations remains to be made as an event distinctive from those in which no problem-solving process is required.

Within the Piagetian tradition the study of everyday practices is still a developing field. However, I found Piagetian interpretations useful for addressing the problem in all its dimensions: epistemological, psychological and pedagogical. In this report I adhere to the central thesis of Piaget´s theory and only occasionally refer to other Piagetians. In this sense I struggle both to introduce this theoretical perspective into adult education discussion and develop Piaget´s constructivism, interactionism and equilibration explanations in addressing work-related activities.

My own interpretation, based on Piagetian Genetic Epistemology and Psychology, is that continuities should also apply to the cognitive level. The processes of problem solving and the constitution of knowledge at work need understanding in order to bridge activities in formal and informal settings. Everyday knowledge or out-of-school knowledge of participants in adult educational practices should constitute the starting point of any pedagogical intervention.

However, how to intervene pedagogically starting from something we commonly ignore? What is this knowledge constructed in everyday life like? How is knowledge used in work-related activities? The present study emerged from the process of looking for answers to these general questions; the focus is on the everyday knowledge of adults with little or no schooling.

Object of Study

The object of study is problem solving and constitution of knowledge at work with adults who have little school experience. The origin of the research is the inconsistency identified in *Educación Popular* in Argentina. The theoretical framework is Genetic Epistemology and Psychology (Piagetian theory). Discontinuities between the epistemological, psychological and pedagogical level are analyzed in order to locate the object of study. Constructivism, interactionism and their explicative process of equilibration are examined as central theses of Piagetian theory.

I concentrate on three working contexts: a) domestic work b) building work and c) rural work, the latter involving domestic help and housewives. Within each one of these settings I have considered some specific practices for analysis e.g. the preparation of jam, the building of an octagonal corner and the pruning of fruit trees. I apply a Piagetian methodological approach in collecting and analyzing the empirical data.

Therefore, I focus on task-oriented problem situations as a particular mode of knowledge constitution and the use of knowledge in carrying out everyday work-related tasks. Relevant cases are selected to show the use of knowledge and problem solving at work of illiterate adults.

When dealing with problem solving, my concern is specially in the characterization of problem situations, i.e by developing a theoretical interpretation of subjects' descriptions. I analyze the constituents of the task-oriented problem situations in relation to social constraints that emerge in the problem solving procedure. The constituents are the problem solver, the objective elements of the situation and the social context.

In relation to subjects' everyday knowledge, I am interested in observing knowledge constructed in particular work-related practices. Thus, I try to capture the nature of cognitive activity in everyday situations by showing the interactive and constructive character of everyday knowledge. The study supports the idea that formative processes of knowledge of illiterate adults do not seem to be far from those of educated people.

Structure of the report

The first chapter introduces the context and conditions under which the study evolved. I present a general picture of the situation of illiteracy and adult education in Latin America as the general arena from which the initial research questions arose. I analyze in particular some weaknesses of *Educación Popular* and the need to develop these kinds of basic studies. The analysis of internal continuities and discontinuities underlying the concept of *Educación Popular* is proposed. I briefly characterize the main aspects of this educational conception, its dimensions and obstacles in locating the focus of the present study.

Chapter two introduces Piagetian Genetic Epistemology and Psychology and the potential of the theory for understanding adults' cognitive processes. I analyze the constitution of knowledge on three levels of reflection: the epistemological, the psychological and the pedagogical. I intend to clarify some theoretical aspects and to pose some questions regarding different ways of understanding the relationship between the subject and object of knowledge and consequently the repercussion this relationship might have on each of the above-mentioned levels. The constructivist and interactionist theses of Piagetian theory constitute the basis for presenting the theory. I analyze the difference between learning in a strict sense, learning in a broad sense and development, as well as the central role of the actions in Piagetian theory.

Chapter three presents the main points of Piagetian equilibration explanations as the third central thesis of the theory. I analyze the role of perturbations in the equilibration process of cognitive structures. The significance, the task, the cognitive obstacle and the success are presented as underlying conditions of a problem situation. I discuss different approaches for dealing with and characterizing problem solving in formal social settings, such as the school, and everyday or informal settings, such as the workplace.

Chapter four refers to the methodological process. I discuss Piagetian clinical-critical exploration and the use of Piagetian methodology in adult education. Afterwards, I present a characterization of the sample and the way the subjects were contacted. I describe the methodological process through each of the different stages for constructing the latest interview. The reason for presenting this process is connected to the struggle to construct a clinical interview from the subjects´ point of view. Finally I discuss the limits and possibilities of the data collected for the present study.

Chapter five introduces the constituents of a task-oriented problem situation: the problem solver, the objective elements of a situation and the social context. I present a model for characterizing a task-oriented problem situation at work. An empirical case is presented for analyzing the relationships of the constituents and the constraints under which the problem solving procedure develops. Work routines are characterized and, therefore the constituents of a task-oriented problem situation are analyzed in relation to work routines.

Chapter six presents a detailed analysis of the problem solver, the objective elements of a situation and the social context as constituents of a task-oriented problem situation. Two empirical cases for each of the constituents are analyzed. The focus of the analysis is the constraints inherent in each constituent as well as constraints which emerged when relating the constituents.

Chapter seven refers to the use of knowledge in everyday situations. Three different cases are presented: a) preparing jam; b) building an octagonal corner; and c) pruning fruit trees. The analysis shows how illiterate adults use knowledge in work-related activities. The cases reveal the constructive and assimilating activity of the subjects which characterize their progressive development of everyday knowledge.

Chapter eight draws attention to the relation between research and practice. The obstacles and necessities for further research is analyzed to narrow the distance between research and practice. The importance of studying everyday knowledge is stressed for improving literacy programmes. In this sense, the unification of theoretical dichotomies is central to the achievement of an integral development of research and practice. The theoretical dichotomies knowing subject / knowing object and problem solving / constitution of knowledge are particularly analyzed.

Chapter nine presents the general conclusions of the study. I summarize the results and thereafter I point out some crucial aspects related to the results of the study and further research.

Finally, the study emphasizes the need to use the potentialities of illiterate adults as a starting point for educational intervention. Accordingly everyday knowledge of adults could be utilized in different kinds of educational practices. Piagetian theory proves to be a useful approach here to understand adults' cognitive processes at work.

1 - CONTEXT OF THE STUDY

I shall begin by considering my standpoint on adult education because this study has its origins in previous observations carried out in schools for adults. This study may help to rethink the pedagogical intervention in adult basic education. For this purpose, I shall identify some general aspects of adult education in Latin America to focus my field of interest. I shall also point out two general reasons why adult education is the centre of interest.

First, there are the alarming rates of illiteracy and school failure registered in Argentina and in the rest of Latin America, and attempts to respond to this situation have been rather unsuccessful. Of the 626 million illiterates in the World, 44 million are living in Latin America.[3]

The second is the preparation of a qualified working force which involves social political processes and economic issues. At the same time, there are attempts to find mechanisms which could facilitate greater participation of the civil society in the democratization processes.

---

[3] Rates of illiteracy vary within Latin America. While Chile, Uruguay and Argentina exhibit a rate of illiteracy lower than 10%, in countries such as Mexico or Brazil approximately one third of the adult population is illiterate. Cases such as Haiti and Guatemala present the worse rates of illiteracy with over half of the population unable to read and write (Hernandez 1989, 67).

During the last decade, Latin America has been the stage for varied policies and strategies towards the solution of these questions based on conflicting pedagogical conceptions. However, the truth is that as we enter the 21st century, the romantic claim of eliminating illiteracy by the year 2000, as expressed by the Ministers of Education and Economic Planning of the Latin American States (México 1979 Proyecto Principal de Educación para América Latina y El Caribe), is confronted with a reality of 44 million illiterates.

Meanwhile, from the first intentions[4] to educate the adult population of Latin America, with the agricultural expansion plans of the 30s, one adult generation after another has been excluded from the written culture.

In these circumstances a great number of projects have been launched by the State and by non-governmental orgaizations (NGOs). These attempts have generated and continue to generate opposition, conflicts and paradoxes in relation to political and technical-pedagogical aspects: centralization/decentralization, service covering/quality of services, pedagogical responsibility/pedagogical spontaneity. However, very little systematization and evaluation of the programmes exist (Sirvent 1994, 35).

The conditions in which illiteracy develops, as well as the multiple causes of children's school failure are particularly important questions to investigate. Illiteracy in Latin America includes vast population sectors who may be participants (or at least potential ones) in adult education.

---

[4] For the analysis of the historical evolution of adult education in Latin America see Barquera 1982, 13-49; Puiggrós & José & Balduzzi 1987; Castillo & Latapí 1981.

Therefore, it becomes essential to debate adult education in the context of general education. In fact, in my judgement there are at least two important aspects to be analyzed in order to understand the problem in an integral and integrated way.

First, adult education as an educational modality has its origin in the failure to educate the population during childhood. In all the world school failure is most common in Latin America. This should alert us to reflect on the way we are tracing and developing the literacy of the younger generations.

In this process, I am not disregarding the multiplicity of political, economical and historical causes operating to maintain and increase illiteracy. On the contrary, I attempt to go beyond optimizing educational possibilities. Educational studies are often bound by structural conditioning offering either hopelessly inappropiate answers or utopically radical solutions. Instead I believe that structural conditioning must be socially transformed. Generally, those who study cultural deprivation are accustomed to characterize the children of this sector as disadvantaged or lacking, simply because they do not seem to respond to school expectations. Now, is it true that those children know nothing that would be relevant in school (Ferreiro 1987; Carraher, T. & Carraher, D. & Schliemann, 1989)? Is there not any kind of knowledge acquired outside the systematic educational actions that might be used in the process of knowledge construction? The same questions apply to adult education.

These children, today´s adults, constitute the population without schooling and thus are the object of attention of adult education. The analysis of this situation creates a challenge to the traditional justifications of school failure. It is not possible to continue explaining the failure of the educational system only through social-political and economic conditioning. It is necessary to include in the discussion the failure of the system itself. In other words, the failure of the school or any other kind of educational organization.

To place the causes of school failure on our being underdeveloped or dependant capitalist countries (no matter what the thesis is)[5], cannot keep on releasing us from the responsibility of reflecting critically in order to construct a better educational system.

Secondly, another reason that justifies the analysis of adult education within the frame of general education is the need to transcend the immediacy of the reality. The issues raised have wider repercussions for adult education. An undeniable and necessary priority must be made to guarantee the literacy of the existing illiterate population. But it is simultaneously necessary to think and find a solution for adult education.[6]

Historically the central preoccupation, at least evidenced in the policies and strategies developed in adult education, has been the basic skills, that is reading, writing and basic calculations. Little was done with respect to the problem of post-literacy. In addition education was not connected with production, or when it was, it was not taken seriously. Adult education always occupied a secondary place for policy makers. Similarly, the role of the mass communication media and leisure time or the non-working time of the population were disregarded.

---

[5] See Wynia 1990; Ormeño 1989; Frank 1971.

[6] I refer to adult education as any intentionally organized educational practice undertaken by adults. I do not limit the idea of adult education to a particular kind of organization or institution like State institutions or civil organizations. Adult education includes all levels from adult basic education to continuing higher education as well as other practices like vocational education or workers' education.

Post-literacy seems important to me, not only for the dynamic of constant change that modern society is obliging us to face, but also for the fragility of the democratization processes we are experiencing throughout Latin America, focusing the theoretical and practical efforts upon the solution of the educational problem. This is to say, when we search for a greater and greater social autonomy for the whole society.

Finally, I find that one among the possible and necessary ways for facing the educational problem is to rethink the pedagogical intervention in all its dimensions. Education may very well be a valid tool for the development of social autonomy. But this tool should still be developed and optimized. It is not possible to rethink the pedagogical intervention independently from the subjects and their everyday experiences anchored in particular social settings. Though some research programmes (Cole & Scribner 1974; Rogoff & Lave, 1984; Lave 1988; Saxe 1991; Nunes & Schliemann & Carraher 1993; Masingila 1994) have been developed for understanding everyday cognition, still much work remains to be done.

1.1 *Educación popular* in Latin America

Educational practices on different levels and modalities are developed on the basis of various theoretical assumptions. I do not attempt a historical analysis of the pedagogical conceptions in Latin America, but I focus specifically on *Educación Popular* as I see its theoretical formulations as most relevant to this research report.

Even if this conception today appears in general education, its origin and its greatest number of experiences are carried out in the field of adult education. Furthermore, my object of study can best be understood regarding the difficulties and discontinuities observed between the epistemological, psychological and pedagogical levels of analysis applied to *Educación Popular*. Thus, I believe it necessary to point out some inconsistencies I identified in relation to *Educación Popular*.

The idea of *Educación Popular* presents severe difficulties to be addressed without any of its defenders or representatives feeling excluded, especially because of the multiplicity of its forms and contents. I shall only focus this analysis on the idea of *Educación Popular* born and developed at the end of the 1950s and in the beginning of the 1960s in Latin America[7] (Freire 1974, Freire 1976, Barreiro 1974, Mendes 1966) Nowadays, it is already possible to speak of a central core that permitted unification of the distinct positions in relation to this idea. I could say that this model or ideal of education is characterized by the search for the individual and social autonomy of the lower sectors of the society. Social autonomy must be regarded with relation to the democratization processes, that is, narrowing the distance between civil and political society by popular participation.

Educación Popular places a special emphasis on the educational processes instead of on its outcomes. This is to say, the how seems to be stressed rather than the what in education. Furthermore, this process is characterized by the intent of bringing together different dimensions of the social order: the confluence of what has been denominated the "pedagogization of politics" and the "politicization of pedagogy".

---

[7] Although Educación Popular may be understood in many different ways, I shall stick with the educational ideas put forth by Freire and the educational movement which afterwards developed them. However it is worthwhile mentioning that what happened from the 1950s on is the conceptual consolidation of this educational movement; experiences of popular education go back to the end of last century with the educational activities carried out by the emerging industrial proletariat.

Politicization of pedagogy: This process of fusion is identified (Lovisolo 1988, 5-12) considering two fundamental ways. First, the goal of *Educación Popular* is to achieve the autonomy and emancipation of the masses. Originally goals of this kind -autonomy and emancipation - were exclusively in the political sphere, as was the capability to achieve them. *Educación Popular* brings these goals into pedagogy. Second, *Educación Popular* sees the relationship between participants in the educational process as egalitarian - horizontal. Within Western liberal thought this kind of egalitarian relationship has since the Ancient Greeks, been regarded as appropriate to and characteristic of participation in the *polis*. That is, it is exclusive to political life. *Educación Popular* brings this kind of relationship, characteristic of politics, into pedagogy.

Pedagogization of politics: The privileged position conceded to political actions is analyzed in this process (Lovisolo 1988, 5-12). Basically, this aspect resides in considering the field of politics and its actions (conflicts, battle, resistance, hegemony, leadership, consensus, among other themes) as privileged arenas for learning or education[8] from the social point of view. The experience of such practices offers possibilities for reflection. In doing so, *Educación Popular* creates its own methodologies of education based on reflection and permanent evaluation of the process seen as a form of political experience. In other words, Educación Popular incorporates from its origins the values and orientations characteristic of active pedagogy.

Another characteristic of *Educación Popular* is related to its origin. It emerges principally from concrete experiences developed by base groups (political parties, trade unions, church militants, etc.). In this context, one of the fundamental reasons that mobilized and keeps on mobilizing popular educators is their commitment to the oppressed sectors of society. Analyses try to support the view that literacy should not remain in the hands of the dominant class, instead the people itself must take responsibility. State education is understood as a tool of the dominant class to reproduce the existing relations of power (Bourdieu & Passeron 1970/77). The thesis would be: within State institutions there is no room to develop *Educación Popular* (Argumendo 1982, 127-37)[9]. This thesis is based on the belief that the dominant class, capital, State and workers of the state are absolute and permanent identical categories (Paiva 1980, 81). Therefore, educational opportunities subordinated to state control could not develop the principles of *Educación Popular*.

---

[8] The absence of distinction between learning and education as well as between political and pedagogical action constitute in my view a weak point of *Educación Popular*.

This position began to lose strength from the 1980s on in Latin America (though not totally) when State institutions were recognized as arenas to be taken over and transformed . This change occurred through two main processes. One of them was the modifications of institutions in Latin America by the recuperation of democracies and the other through the increasing weakness of the traditional reproductivist argument in education (Rockwell & Ezpeleta 1983, Llorente 1991b).

---

[9] This article tries to answer the question: What is *Educación Popular*? by presenting five theses which are partially true but provide false results when applied dogmatically. They underlie the idea of *Educación Popular*. 1. *within State institutions there is no room to develop Educación Popular 2. any educational activity that is beyond State control is Educación Popular 3. the aim of Educación Popular is just conscientization and to the elaboration of a counter-ideology 4. any political action developed by popular groups is Educación Popular 5. Educación Popular does not need educators.*

In addition, at the basis of *Educación Popular* educators and ideologist have felt an urgent need to find solutions in accordance with the social-historical conditions of the reality to transform and to construct a *Latinoamerican* pedagogical theory. This aim of constructing a cultural-historical based pedagogy was an answer to prevent the extrapolation of the international discussion on adult education led by international organizations like UNESCO. *Educación Popular* wanted to be an alternative to concepts such as *Education Permanente*[10] and adult education conceived as compensatory education. *Education Permanente* was mainly rejected by the movement of *Educación Popular*. However in some cases it was accepted as a framework for the development of *Educación Popular* because it was wide enough to be adjusted to the socio-historical conditions of Latin America.

A theoretical background began to be constructed related to these experiences (Freire 1972; Freire 1974; Freire 1976; Barreiro 1974; Mendes 1966; Barquera 1982, 13-49; Chaparro 1980, 4-9; Gajardo 1985, 11-35; Sirvent 1994). The thesis development/underdevelopment/marginal sectors was replaced by the thesis capitalism/dependant capitalism/oppressed sectors[11]. In this sense the *Educación Popular* is expected to reinforce the construction of an alternative model of society, rooted in the interests of the popular sector (Castillo & Latapí 1981, 62). An historical project is inherent in *Educación Popular* and proper to the lower social classes it is a project that is emerging and in the process of expanding in definition, from which its utopia and its inspiration derive.

---

[10] I refer to the concept or proposal emerged during the 1960s (UNESCO Conference, Paris 1966) developed further during the 1970s (UNESCO Conference, Tokyo 1972). *Education Permanente* looks for answers to the neo-capitalism crisis i.e. rapid production of knowledge, obsolescent knowledge, need for curriculum development, leisure time, systems of communication development, difference between educational opportunities and population demands. *Educacion Permanente* refreshes the old idea of education-change. Barquera (1982, 29-30) identifies four main features: a) continuity; b) redefinition of educational agents and agencies; c) link between education and development in the professional, political and cultural spheres; d) cultural reactivation.

These theoretical presumptions, that were propagated in Latin America with more and more radicalized dogmatism, generated intense encounters between educators who defended or rejected these positions. In this sense it is very difficult to qualify one sector or another as progressive or conservative, at least in principle, due to the fact that both sectors possess educators and thinkers who seem to be committed to the construction of a more just society.

1.2 Dimensions of *Educación Popular*

It is possible to collect a kind of core of views within *Educación Popular* by presenting the shared features through different dimensions of analysis. Sirvent (1994, 19) presents five common aspects shared by the experiences of *Educación Popular* in Latin America. I present these in Figure 1 as dimensions following the analysis presented by

---

[11] The first thesis sees underdevelopment as a transitional state towards development. From this view marginal sectors are functional to the system and they are somehow responsible for their condition. The second thesis sees Latin America within the capitalist world as dependent on the central economies. The poorest sectors of society are oppressed by dominant sectors as capitalist societies are oppressed by dominant ones. Therefore liberation from both dominant sectors and central economies is the way to break the cycle. The liberation process is the responsibility of the oppressed sectors.

Sirvent[12] together with my own proposal. The term dimensions refers to levels of analysis which are taken into consideration in finding similarities within the broad set of interpretations that experiences of *Educación Popular* present.

DIMENSIONS	socio-political	socio-historical conditions	
	popular		
	cognitive	psychological	LEVELS
	epistemological	epistemological	
	methodological	pedagogical	

Figure 1. Dimensions and levels of analysis of *Educación Popular*

Socio-political dimension: On the one hand, *Educación Popular* sees in the Latin American societies an increasing process of social and economical differentiation. The economic development and distribution of goods and services continue to preserve social injustice and maintain the *status quo*. On the other hand, *Educación Popular* is based on the idea of social transformation towards the development of the popular sectors to participate in decision making which affects peoples' everyday lives. This participation is understood as a historical conquest and learning to realize one's own interests and personal aims.

---

[12] Sirvent uses the terms "epistemological foundations" and "methodological aspects" instead of dimensions. The explanations of these dimensions are my own translations from Sirvent 1994. *Educación de Adultos: investigación y participación. Desafíos y contradicciones*. Ed. Libros del Quirquincho. Buenos Aires.

Popular dimension: this refers to the collective actors[13] and the objectives of *Educación Popular*. Educational actions are seen as supporting tools of the popular organization and the construction of its own social-political project.

Cognitive dimension: *Educación Popular* is a process of circulation, appropriation and collective production of knowledge. This process tries to objectify everyday life, to make a critical analysis of it and to elaborate aims and instruments for action.

Epistemological dimension: *Educación Popular* sees knowledge as dialectical construction and not as a result of a linear limitless accumulation of more or less disconnected facts. Knowledge of reality means the understanding of facts as structural parts of a changing whole. The essence of facts is looked for behind the appearances. Dialectical knowledge assumes that human thinking goes in a spiral starting from one point and coming back to it but enriched. The concept of praxis (which breaks the dichotomy of theory-practice) as well as the notion of construction of the object of study are central ideas in the epistemological and cognitive dimensions of *Educación Popular*.

---

[13] Popular sectors are seen as the *sujetos de acción* of *Educación Popular*. I use the term collective actors because this case refers to a social sector and not to individuals. The idea of *sujetos de acción* stresses the protagonist role of the popular sectors as opposed to being passive participants in educational actions.

> **Methodological dimension:** *Educación Popular* starts with the description of problematic situations experienced by the participants in the process, the search for causes and consequences, the determination of aims and instruments for action by a collective construction of knowledge. This process of collective construction evolves in the dialectic relation between common sense and scientific knowledge. This proceeds by taking experience, everyday life and practice as objects of reflection. Critical reflection develops conceptualizations and historical analyses to go beyond the pragmatic perception of problems by creating a collective conscience about them.

The characterization presented by Sirvent (sketched on the left of Figure 1) may help to characterize the so called movement of *Educación Popular*. However the identification of shared issues should be done in a way that allows critical analysis of the basis of *Educación Popular*. In my view the scheme presented above fails in granting the same hierarchy to each dimension. The analysis confuses essential constituents of the pedagogical conception with the socio-historical conditions in which they develop. The socio-political and popular dimension are characterizations of the conditions under which this educational conception runs rather than distinctive features of the conception. (see the right side of Figure 1)

With respect to the socio-political dimension I reject the arguments. First, the identification of social injustice and its maintenance is also accepted in non-alternative educational conceptions. Teachers Trade Unions historically pointed out this situation even when they belong to State institutions. Second, the idea of social transformation towards the participation of the popular sector in political life is also present in so called traditional experience regulated by the State in terms of democratization processes.

With respect to the popular dimension I must criticize the misleading reason for presenting this aspect as a dimension of *Educación Popular*. The activeness ascribed to the popular sector in the educational process is something that fits better in the epistemological and cognitive dimension as it refers directly to the position of human beings in the world, including the social world. On the other hand, if educational actions are seen as supporting tools for popular sectors to construct their own socio-political project, then popular sectors must be clearly defined which is not done. Probably the main error has been to reduce popular sectors to the proletariat and to suppose the natural existence of working class consciousness. In any case, wherever the limits of the popular sectors are placed, the ambiguity of the concept requires specification in every particular case. The term popular suggests but does not make clear the nature and extension of the phenomena (Beisiegel 1979, 79). Therefore, it does not help the characterization of central issues shared by the different experiences of *Educación Popular*. Freire has already anticipated the risks for popular educators of producing opposite results to what is expected.

> Unfortunately, those who espouse the cause of liberation are themselves surrounded and influenced by the climate which generates the banking concept, and often do not perceive its true significance or its dehumanizing power. Paradoxically, then they utilize this very instrument of alienation in what they consider an effort to liberate. Indeed, some revolutionaries brand as innocents, dreamers, or even reactionaries those who would challenge this educational practice. But one does not liberate men by alienating them (Freire 1974, 52).

It is sensible to focus on the interrelation between the epistemological, the psychological and the pedagogical levels. This view allows us to identify internal continuities and discontinuities of this pedagogical conception. The cognitive dimension could fit with the psychological level. The methodological aspects presented by Sirvent must be considered in a wider perspective including the different elements that constitute an educational situation.

1.3 Obstacles

Efforts to defend the libertarian ideals of *Educación Popular* have unfortunately not always resulted in better opportunities for the popular sectors. On this point, what is possible, and at the same time necessary, is to dare to question the effects generated by the rigid defence of the libertarian ideals involved in those claims: effects which it would be necessary to analyze on the pedagogical level.

In this sense, have not the same pedagogical schemes been reproduced by most of the different educational opportunities for adults? It is difficult to imagine that the literacy efforts, carried out from within the framework of *Educación Popular*, achieved results that differed from the traditional efforts carried out by official organizations. These efforts are often characterized within educational functionalism and as simple adaptations of school curricula for children.

How is it possible that a radically distinct conception may produce similar results? A possible approach to answering this question might be to analyze what is going on within the concrete learning processes at the various stages the civil society and the State have created for educating their members (schools, literacy centres, work training centres, etc.).

A need for revising theoretical and methodological constituents of *Educación Popular* has been recognized in recent discourse. Sirvent (1994, 34) points out some obstacles which must be removed in order to prevent the depoliticization[14] of *Educación Popular*. These obstacles can be summarized as follows:

- Practice and spontaneity are observed in the rejection of theory and the lack of reflection by *Educación Popular* as pedagogical practice. In other words, there is no objectification of the practice.
- There is no systematization and evaluation of the social and educational impacts of experiences.
- Distortion and simplification of the theoretical and methodological postulates by reducing *Educación Popular* to models for organizing group activities.
- Ambiguities in the notion of participation. The absence of norms and the lack of efficiency of the educational work.
- Misunderstanding of the relation of scientific-technical knowledge/popular knowledge.
- There is little research in this field. The situation is aggravated as the participative research does not produce evidence that contributes to scientific understanding of knowledge production.

These obstacles have transformed *Educación Popular* from its origins into a kind of pedagogical populism unable to reach the complexity of social reality and to answer accordingly. In addition to all these obstacles it is crucial to concentrate efforts on the pedagogical level of

---

[14] There is a certain agreement among adult education sociologists to identify the weakness of the civil society by an increasingly process of fragmentation, atomization, demobilization of the popular sectors, specially the working class (Sirvent 1994, 29).

Educación Popular which is still underdeveloped. I sketch the problem and the strategy for solution which I take for the present study.

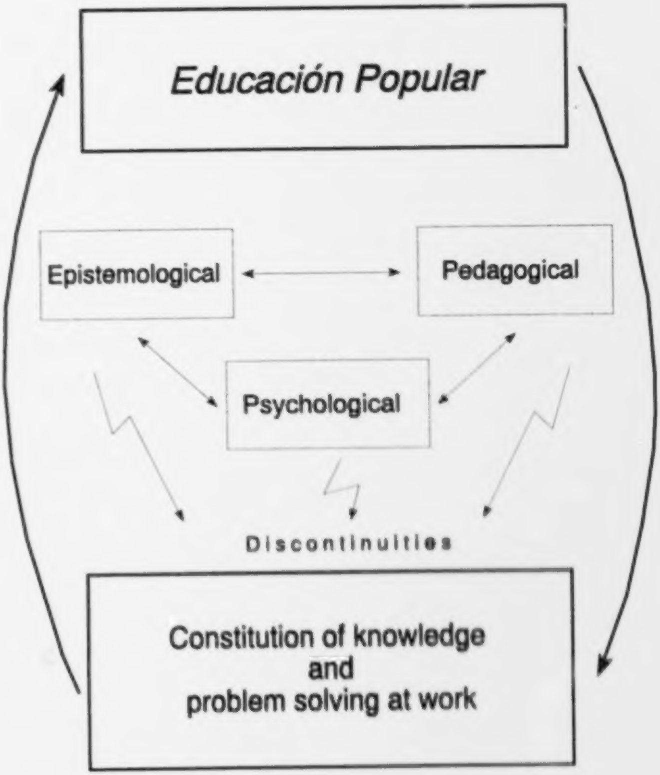

Educación Popular
Epistemological
Pedagogical
Psychological
Discontinuities
Constitution of knowledge
and
problem solving at work

Figure 2. Origin of the research problem

Discontinuities among the three levels of analysis proposed cannot be addressed independent of the subjects on these levels: the epistemic subject, psychological subject and pedagogical subject. Discontinuities between epistemological and psychological levels can be solved theoretically. However as soon as we focus on the pedagogical level we have to deal with questions which require empirical treatment.

It is necessary to produce a coherent educational design on the pedagogical level based on information about subjects' natural ways of performance in everyday activities. It is not possible to foster development without knowing what and how development evolves. Contrary to this, *Educación Popular* is ignoring the learners who are at the centre of the educational process.

In this study I concentrate on subjects' work-related activities considering two main relevant issues: constitution of knowledge and problem solving. Both issues look for answers to sort out discontinuities on the pedagogical level. I use and develop Piagetian interpretations to reach theoretical and empirical understanding. Piagetian epistemological and psychological ideas do not contradict the basis of *Educación Popular* on these levels but go beyond and certainly help our understanding of the problem.

1.4 Discontinuities

The analysis of any educational alternative cannot be reduced to a politico-ideological characterization. The specificity of the pedagogical intervention requires the examination of the educational design processes and educational planning. Focusing on this issue we may find whether original answers are created or the existing inequality is unreflectively reproduced (Puiggrós & José & Balduzzi 1987, 26)

The learning problem is often approached exclusively on the pedagogical or psychological level. Educational designers begin from a determined pedagogical theory, based on a critical discourse towards epistemological empiricism. But, later they deal with assumptions based on empiricism and develop them into more concrete areas of educational production. I find that in general education and in that of adults in particular, theoretical standpoints are withdrawn or disappear on the level of pedagogical interventions.

Adult education in Latin America seems to have constituted one of the propitious fields for acknowledging this discontinuity. *Educación Popular* takes on some aspects of the epistemological constructivism, essentially in the analysis of the relationship between education and society. The subjects, whether schooled or not, are viewed as constructors of society. However, in the moment of effectively teaching, people often follow behaviourist proposals, and in others simply denaturalize education in its most profound sense, denying the pedagogical intervention[15].

Within adult education, the positions that follow the ideals of *Educación Popular* are perhaps those that most clearly indicate that the social order is constructed.

> Bit by bit, these groups begin to see themselves and their society from their own perspective; they become aware of their own potentialities. This is the point at which hopelessness begins to be replaced by hope. Thus, nascent hope coincides with an increasingly critical perception of the concrete

---

[15] Pedagogical intervention refers to educational design. However I intentionally use the term intervention in order to stress the role differentiation in educational situations. The confusion of roles and the lack of content in the process is a crucial point underlying the failure of *Educación Popular* practices.

> conditions of reality. Society now revels itself as something unfinished, not as something inexorably given; it has become a challenge rather than a hopeless limitation. This new, critical optimism requires a strong sense of social responsibility and of engagement in the task of transforming society; it cannot mean simply letting things run on. (Freire 1972, 13)

The social responsibility and engagement claimed by Freire are not enough if we cannot conceptualize them scientifically. Statements of this kind dominate the discourse and experiences in adult education. Intervention upon reality to transform it requires planning and tools which must be in congruence with the transformation aimed at. This is not possible unless we rethink the way educational activities are being developed.

As the methodology of *Educación Popular* Sirvent (1994, 193-99) describes the method of mental training[16]. I present an excerpt of this description to show the contradictions that appear and the break with both the epistemological and the psychological level.

> This methodology **takes as starting point the reality as it is** to construct knowledge on it. It is assumed that knowledge is constructed by a series of actions on objects. Actions or operations are articulated by logical organization of thinking. Thinking works according to structures which, **as empty moulds**, are applied in the interaction subject-environment and therefore are **filled up with contents** (Sirvent 1994, 194) [Own translation] [bold is mine].

The key problem is that reality cannot be viewed apart from the knowing subjects if we do not want to contradict the constructive character of reality. What is reality? Who decides what reality is? Is it the reality of the popular educators or the reality of the participants in the educational process? The statement breaks with a central epistemological issue in *Educación Popular,* the role of the knowing subject in a process of knowledge constitution. It is assumed that knowledge is constructed but that cognitive structures are empty moulds which, in interaction with the environment, are filled up with contents of reality. Despite some internal contradiction in the excerpt it is certainly a coherent empiristic statement contrary to the central essence of *Educación Popular.*

---

[16] The "mental training" method of adult education was created in France at the end of the Second World War by the group *Peuple et Culture* promoted by Jofre Dumazedier and Paul Legrand (Sirvent 1994, 194).

This relation between methodologies and theoretical frameworks is a central point for world-wide adult education. Often techniques and methodologies in education are applied apart from theoretical underpinnings breaking the coherence and continuity between learning and education. This discontinuity in adult education is frequent and is related to the absence of unified criteria which identify differences and similarities between learning and education and to examine carefully the interrelation between the epistemological, the psychological and the pedagogical levels.

Focusing on the psychological level, *Educación Popular* sees the learner as an active subject. Freire refers to this active condition of the subjects saying quite clearly

> They organize themselves, choose the best response, test themselves, act, and change in the very act of responding. They do all this consciously, as one uses a tool to deal with a problem. Men relate to their world in a critical way. They apprehend the objective data of their reality (as well as the ties that link one datum to another) through reflection - not by reflex, as do animals (Freire 1972, 3).

Nevertheless, *Educación Popular* often treats the individual as a passive being when using methodologies and techniques which contradict the constructive nature of individuals. An example of this can be found, among many others, when analyzing how the literacy manuals sequence and administer the learning process.

What is important to reflect on, when trying to release ourselves from ideological traditions or adjustments, is the fact that systematic education, whether formal or not, is effectively produced on the level of pedagogical interventions.

It will be difficult for education to contribute something to the construction of the society, if on the pedagogical level the possibilities of construction are denied by applying behaviourist proposals[17] or not intervening pedagogically as the result of confounding education with social work. The argument of cultural respect for the students is presented to justify the absence of pedagogical intervention, but without defining what is to be to respected. Therefore, educational work is reduced to instrumentalist practices (Argumedo 1982, 127-37).

These practices, on the other hand, constitute a serious danger as they appear and are spread as progressive ones. This occurs in the pedagogical field as well as in the whole social sphere. Then they become mainly conservative or reproductive actions.

> It would be naive to expect oppressor elites to denounce the myth which absolutizes the ignorance of the people; it would be a contradiction in terms if revolutionary leaders were not to

---

[17] I refer to behaviourist proposals in a radical sense stressing the passiveness assigned to learners when organizing and conducting educational activities. In Chapter 2 I present some excerpts from observations in school for adults where the teaching activity takes over the educational relationship leaving little possibility for learning.

> do so, and more contradictory still were they to act in accordance with that myth. The task of revolutionary leaders is to pose as problems not only this myth, but all the other myths used by the oppressor elites to oppress. If, instead, revolutionary leaders persist in imitating the oppressors' methods of domination, the people may respond in either of two ways (Freire 1974, 105).

In my opinion, it is not sufficient to think of the popular sectors in Latin America as protagonists constructing a new social project. Education has much to do in this sense if it is to actually generate the possibility of constructing a new social project. This implies, first, that the sector in question, unschooled adults, is recognized as having both the capability of constructing knowledge and the desire and the right to learn. Second, the social and pedagogical responsibility must be taken by both the civil society and the State to educate them effectively. This should be understood as fostering the subjects' critical reflection as well as developing and empowering autonomy.

The aim of this work is to seek elements that would provide us with that necessary background in order to be able to intervene pedagogically, in the most coherent way; or at least to rethink the present way of acting.

1.5 The research project

The search for elements that permit the rethinking of the pedagogical intervention, from a constructivist framework has been the starting point of the present study. Theoretical and practical inconsistencies that I have observed in the field of adult education directed my interest towards a basic study of the particular processes of constitution of knowledge and problem solving of adults with little schooling in out-of-school contexts.

In this study three specific work contexts were considered: building, rural and domestic work. Therefore, within these contexts, I focused on certain particular practices, such as the ones analyzed. I have tried to develop some aspects of Piagetian thinking to analyze work-related activities of adult subjects, achieving some results. But, rather than concluding this analytical perspective at this point, the results should open new vistas for further studies, focusing on problem situation designs. In my view, this is a crucial theme for bridging illiterates' natural ways of understanding and performing in everyday settings with pedagogical intervention in formal settings. It becomes particularly relevant to examine the workplace of the potential participants in educational practices.

In all the cases, I was concerned with the activities I would define as artisan types, or at least activities that require the manipulation of materials and instruments. These kinds of activities differ from other work practices in serial production, where the worker has a very predetermined task as a part of a production line. It would be flippant not to consider that differences between both types of work might exist. However, it is possible to hypothesize that in serial production or in non-artisan types of work, task-oriented problem solving and the processes of knowledge constitution simply take different modalities for the same active epistemic subject. I understand that empirical evidence in manual types of work may not be generalized to any extent, disregarding the specificity given by either the particular task or the distinctiveness of the social setting. But, in terms of the active epistemic subject, the generalizability, at least theoretically, reaches any social setting and working activity through the mechanisms of knowledge constitution.

I find this distinction important, anticipating possible reductionist analyses that might not value the artisan or manual types of work practices, due to the characteristics that everyday work-related tasks might have in technologically-implemented economies. Furthermore, even in such cases, the manual or artisan-type of work has not disappeared and occupies a great number of workers who are potential students for adult educational practices.

1.6 Adult education research and practice

Research into adult education in Latin America has mainly focused on descriptive studies and sociologically oriented research. The most influential research approach in adult education is participative research[18]. *Investigación Participativa* constitutes a particular approach to social research. The central aim is to promote the participation of the group involved by objectifying their reality. The process would involve two related processes: a) generating collective knowledge about the reality studied and, b) promoting changes in the immediate everyday life. In my view the *Investigación Participativa* may prove useful in producing critical and collective development in certain social practices. However there are particular research issues which may meet serious obstacles to be addressed in the action itself.

For instance referring to literacy, the gap between illiterates' work-related knowledge and its development through organized educational practices requires special treatment. The understanding of what and how illiterates know with relation to reading and writing and mathematical knowledge calls for epistemological / psychological interpretations as well as particular methodological tools. These are central aspects, though not exclusive, in literacy programmes and should be narrowed by capturing not only what is explicitly observable. On the contrary this needs theoretical interpretation of what is not observable and objectifiable.

---

[18] *Investigación participativa* in Latin America is strongly related to adult education and *Educación Popular*. They are not the same thing but share theoretical formulations. In a wider context the basis of this research approach can be found in Grounded Theory. However in Latin America it acquires particular development in relation to *Educación Popular* (see Sirvent 1994, for a detailed analysis of the origin and development of participative research in Latin America).

Focusing on the macro level adult education research has certainly fostered adult education practices by giving the basis for policy making. This aspect cannot be minimized but it is a partial answer which must be considered together with day-to-day educational practices. In turn, this means reassessing educational practices from a bottom-up perspective by reconstructing the real processes which shape these practices rather than supposing what they are.

Very little research has been done in relation to psychology and educational design in adult education. This situation produces a growing gap between theory and practice. I refer particularly to basic literacy plans and their actual implementation. Psychological research is central to educational design. There is no possibility of improving the pedagogical level without educators knowing more about learners' cognitive processes.

At present adult education practices are disconnected from educational research. At least, they are disconnected to research focused on psychological processes afterwards used in educational design. In the case of *Educación Popular* it is recognized (Hernandez 1989, 67-70) that the theoretical and methodological framework of this educational conception should go hand-in-hand with advances in techniques and methods. I contend that methodological proposals that emerged from *Educación Popular* (Freire's psychosocial method) need revision by examining the necessary coherence that any method or technique should have in relation to its epistemological and psychological roots.

Two main reasons can be pointed out in relation to the disconnections between research and practice.

> First, the poorly defined boundaries of adult education research as a field of knowledge. The constant debate on whether or not adult education constitutes an identifiable field of knowledge in some cases takes researchers' concerns away and, in others deviates research focuses towards issues which cannot influence practice both in the classroom and the workplace. Together with this discussion and the permanent institutional interruptions in Latin America during the present century, struggles with adult education research could not impact on the micro educational level.
>
> Second, the difficulties faced by psychology in order to fit within interdisciplinary studies and to reach the pedagogical level. Educational research aiming at providing methodologies and techniques for the practical level needs psychology as a source of knowledge. The implementation of psychologically-based research in educational practice is a complicated issue in general education and even more in adult education. As a consequence of the ongoing debate on closing or opening boundaries in adult education one rarely finds common places where psychologists and specialists in adult education cooperatively produce research work.

Educación Popular, as referred to in Section 1.1, went through a process of expansion in Latin America since the 1960s. *Educación Popular* was born specifically in adult education but nowadays goes beyond it and reaches the discussion in general education. However a reverse process seems to have governed the structuring of adult education research. Adult education research starts within contexts not necessarily and uniquely concerned with adult educational practices, as in the case of universities and NGOs working in many different fields.

A separation from general education characterizes adult education research, at least until the 1990s. Teacher training also follows this general trend. Originally primary school teachers without further specialization assumed teaching activities in adult education. During the 1980s several different in-service training programmes began offering specialization in adult education as well as a teaching career in adult education.

On the contrary the integration of adult education into general education characterizes *Educación Popular*. The original practical works and their conceptualization took place in educational practices with adult illiterates. But soon with the possibilities offered by the democratization processes to broaden the discussions, *Educación Popular* started to be considered in general education as a valid pedagogical alternative for general education.

I would like to point out that even when these two differentiated but related processes can be identified, they have not evolved independently. In fact, the central actors in both processes are teachers or adult educators who in most cases carry out teaching activities in general and adult education simultaneously.

1.7 Summary

The alarming rates of illiteracy and school failure call for a review of the problem. *Educación Popular* offers a good standpoint from which to see the problem, however it is not enough. Solutions to the problem of illiteracy require us to go beyond the politico-ideological analysis of educational alternatives. It is also necessary to find out the internal contradictions of the alternatives. For example, it will be difficult for education to contribute something to the construction of the society, if on the pedagogical level the possibilities of construction are denied by applying behaviourist proposals. Similarly difficulties will arise if educators fail to intervene pedagogically as the result of confusing education with social work.

An analysis of continuities and discontinuities among the constituent dimensions of *Educación Popular* is presented. The main source of the analysis is the interrelationship of the epistemological, the psychological and the pedagogical level. Adult education research in Latin America is discussed.

The obstacles and necessities for further research are analyzed in order to narrow the distance between research and practice. I make reference to *Investigación Participativa* as the most influential research line in adult education in Latin America.

In the following chapter I shall concentrate on the analysis of constructivist conceptions in education by examining Piagetian interpretations on the three levels of analysis proposed.

2 - CONSTITUTION OF KNOWLEDGE

In the previous chapter I presented the conditions under which the research questions arose. In order to answer the questions I focused the empirical study on everyday work-related activities. In this chapter I present a theoretical analysis of the processes of the constitution of knowledge by showing the interrelations between the epistemological, psychological and pedagogical levels.

I use the term constitution as it covers different but related meanings such as construction, formation or production. Kitchener (1986, 136) states that the term constitution conveys in French as well as in English two related notions: the activity of constituting, that is, of establishing and developing something, and the product of this activity - the composition or the make-up of that which is already constituted.

Piaget, referring to this point, states that the process of the constitution of knowledge involves two closely related things: first, the conditions under which knowledge is attained *(les conditions d'accession)* and, second, the conditions that actually make-up knowledge *(les conditions proprement constitutives)* (Kitchener 1986, 136). These two aspects pointed out by Kitchener are relevant because they make clear, or at least open the possibility to make clear, that processes of knowledge cannot be reduced to either of these aspects; both are constituents of the process.

Les conditions d'accession refers to a controversial aspect of Piagetian theory, the role of the context in knowledge constitution. Though in several texts Piaget points out the contributions of the situations or environmental factors in the process of knowledge, he rather focused on the explanations of the knowing subject in the process. However, talking about the development of Piagetian theory it is impossible to reduce the theory to the studies developed by Piaget himself and his closest collaborators. Indeed, there are different approaches within Piagetian theory which already constitute an important research programme.[19]

As to the *conditions proprement constitutives* Piaget (1967, 3-61) states the need to know the factual conditions regarding the relative contribution of the subject and the object in the epistemic situation. These factual conditions refer to the requirement of empirical investigations to assess the contributions or participations of subject and object of knowledge.

In adressing the processes of knowledge constitution I shall first consider Piagetian efforts as an epistemologist in relation to the impact of the popularization of his ideas. Second, I shall consider the use of Piagetian theory in adult education. Third, I shall adress the processes of the constitution of knowledge on three levels, the epistemological, the psychological and the pedagogical by justifying the need for this unified treatment.

---

[19] Regarding social interaction and its relation with cognitive development see Perret-Clermont & Michel Nicolet 1992. For symbolic representation in mathematical concepts see Vergnaud 1985. As to the application and development of Piagetian theory on reading-writing processes see Ferreiro & Teberosky 1985. With respect to everyday cognition using Piagetian interpretations enriched with other perspectives see Nunes & Shliemann & Carraher 1993; Saxe 1991. Reinterpreting Piaget's work and focusing on educational implications see Demetriou & Shayer & Efklides 1992).

2.1 Is Piagetian theory epistemological, psychological or pedagogical?

An answer to this question calls for clarification of the meaning of each of these terms. There are important differences, Piaget claims, between Genetic Psychology, Child Psychology and Genetic Epistemology.

> Genetic epistemology is not to be confused with genetic psychology and the latter is not identical with child psychology. This last is the study of the child himself, whereas genetic psychology seeks within the study of the child the solutions to general problems, such as those of the mechanisms of intelligence, perception, etc., for it is only in analyzing the formation of such mechanisms that we can provide their causal explanation (Piaget 1966/73, V)

Piaget's primary concern was epistemology and he claimed that one can understand the nature of knowledge by understanding the nature of thinking. However one cannot deny the strong impact that Piagetian ideas have had upon teachers and education. Probably Piaget is the most well known psychologist in the educational field, though he never was directly concerned with education. Transference of psychological research to the pedagogical field is still now an important issue. Can one criticize a theory by focusing on the extension of the theory to a new field? Certainly criticisism is crucial for any further development of the theory but it requires some thoroughness. Most of the critics of Piagetian theory focus on the use of Piagetian concepts in pedagogy, often in a disconnected and erroneous way. This kind of criticism does not help the development of the theory as it does not refer to the theory but to an unreflected extension of the theory.

This situation created confusion as Piaget was presented in some cases as an educational psychologist which is different from the epistemologist he actually was. Is Piagetian theory centered on psychological processes in the child?

> Genetic epistemology has as its object the examination of the formation of knowledge itself, that is to say of the cognitive relations between the subject and object: thus it bridges the gap between genetic psychology and epistemology in general, which it helps to enrich by considering development (1966/73 Piaget, V)

Genetic Psychology uses Child Psychology to find out answers to general psychological problems and therefore Child Psychology acts as an instrument. Is it the same to speak about epistemic subject or psychological subject? Certainly it is not the same. Both epistemic and psychological subjects refer to different levels of analysis. Epistemic subject is a theoretical (epistemological) construction while a psychological subject is a concrete individual. Empirical research on psychological individuals comes to prove or contradict the definition of the epistemic subjects. Piaget's struggles to construct a scientific epistemology by examining psychological concrete processes is the basis of this distinction between epistemic and psychological subject.

Kitchener (1986, 187) states that Piaget´s theory of epistemic development concerns the epistemic subject and not the psychological or individual subject. The epistemic subject is an idealized abstraction, namely, that set of underlying epistemic structures common to everyone at the same level of development.

2.2 Piaget's ideas in adult education

Piaget is usually known as a child psychologist. However, his work goes beyond this discipline. He was committed to epistemological challenges, to the construction of a theory of knowledege. Even though I do not aim at giving a complete review and critique of this aspect of Piaget´s work, I see the need to point this out because this study is directly focused on adult education. Thus, those who misunderstand Piaget's work may consider this theoretical perspective for dealing with adults inappropiate.

Piaget's work is often reduced to the study of different stages in development. This probably had to do with the use made of it in education and the popularization of Piagetian ideas. The evidence of stages in development offered by Piaget cannot be denied nor can it be overestimated. This aspect of the theory is descriptive but not essential to the basis of the theory. I find it troublesome to focus on Piagetian description of the developmental stages when adressing issues related to adult education. Indeed the theory offers better possibilities and consistency by analyzing its core concepts. What would happen if stages were left aside in Piagetian theory? It seems that the interactionist and constructivist explanations as well as the equilibration theory would stand without too many problems (Gruber & Vonèche 1977, XXVI).I shall go through these explanations which I consider central to the theory in greater detail later.

Is it possible to adress the processes of constitution of knowledge, problem solving, learning processes of adults from the standpoint of Genetic Epistemology? Epistemological reflection tends to understand conceptual meanings within a certain theory, the heuristic power of the hypotheses, the criteria of comparability with rival theories and also the obstacles that might arise in transfering the theory to a new field (Lakatos 1970; Piaget & García 1982; Castorina, 1992).

Genetic Epistemology and Psychology are aspects of an unfinished theory or research programme. This programme originally focused on the empirical construction of the theory on studies with children. The development of the theory is not tied to one particular field of knowledge even less in the case of Genetic Epistemology and Psychology which is grounded on studies of diverse spheres: logic, space, time, mathematics, science, morality, play and language, and so. It is a theory that is open-ended, tentative and subject to revision (Modgil, S. & Modgil, C. 1983, 3).

However if a theory is extended to a new domain what must be observed is the consistency of the conceptual body to analyze the new phenomena as well as the consistency of the new concepts and hypotheses derived from the new field. In the case of Piaget's theory, this entails the recognition that

> Piaget's theory of cognitive development is commonly and correctly regarded as a theory pertaining to childhood development. However, and to the extent that the theory can be accepted, it can also be regarded as specifying the adult form of cognitive functioning (i.e. the formal operational stage). This involves regarding the same theory as developmental in childhood but specifying cognitive process continuity in adulthood. (Bright 1989, 44)

Piagetian theory has been used in studies related to adult learning. Conlinvaux & Dibar Ure (1989, 173-200) focused on the reasoning of young people at secondary and university level using Piagetian theory. They asked themselves whether the school helps in some way to develop reasoning. How do adults without schooling use their reasoning? What is their everyday life like? And from an intellectual point of view, how do they understand and solve the situations of everyday life? Emanating from such questions, the interest of the authors was on studying the reasoning of non-schooled adults in Brazil.

In 1985 they conducted a study with fifteen adults who were becoming literate, applying clinical interviews about physical conservation. According to the results of these experiments, all the subjects found themselves at least on one sub-stage of concrete operations.

Based on these studies, it became evident to the authors that they needed to explore the reasoning of these subjects. Thus, they decided to work with experiences of sciences related to everyday life. Their explorations were conducted in groups and within the school context. Their attention was centred on what to do with the spontaneous knowledge of the pupil, how to make it grow, to transform and the type of activities to use. In the investigation they included:

a) The problem of water transformation, from the construction of a terrarium. (Colinvaux & Dibar Ure, 1989)
b) The theme of simple electric circuit functioning.
c) The theme of the construction of the notion of space. (Colinvaux & Dibar Ure, 1989)

In relation to the construction of the notion of space, they observed that the "game for localizing the coin" used in the study could be used profitably as an introduction to the theme of maps and graphics.

The application of these results in the educational context would permit us to see things from the student's perspective, observing his/her spontaneous strategies for developing the themes of the studies. They could see in the different experiences developed, evidence of reasoning of a hypothetical-deductive nature.

From a different perspective, Kolb (1993, 138-56) uses Piagetian explanations combined with Dewey and Lewis for presenting a model of experiencial learning. Kolb stresses the interactionist aspect of Piagetian theory and stages of cognitive growth to present a model of adult learning. In his view, knowledge is continuously derived from and tested out in the experiences of the learner. Learning is therefore the process whereby knowledge is created through the transformation of experience. Kolb points out the fruitfulness of the Piagetian approach in analyzing the intimate relationship between learning and knowledge. Thus he recognizes the need for epistemological as well as psychological inquiry into these related processes (Kolb 1993, 154).

However the use of Piagetian interpretations is mainly focused on the psychological aspects of his theory and not very much on the epistemological aspects. In my view Piagetian theory requires the joint treatment of these two aspects because the theoretical fundations were build up by constantly matching epistemological and psychological issues.

2.3 Epistemological-psychological interpretation

In order to clarify the theoretical starting point for the analysis of constitution of knowledge, three levels of analysis are taken into account: the epistemological, the psychological and the pedagogical. Levels are considered as different perspectives of analysis without establishing any hierarchy among them. The central issue is the identification of the existing overlaps between epistemology and psychology to rethink the pedagogical level.

The aim of the present analysis is to observe theoretical-practical incongruencies that often are verified in pedagogical work, regarding modes of understanding the relationship between the object and the subject of knowledge or what could be called epistemological paradigms. Often learning problems are exclusively adressed at the pedagogical or psychological level, failing to recognize its roots at the epistemological level. The intricate relation of these levels demands an integrated analysis regarding questions related to education.

Particularly in the case of adult education it becomes necessary to make the assumed epistemological position explicit. Adult education as a social practice needs interdisciplinary approaches and therefore clear epistemological standpoints to avoid what Bright (1989, 13-62) calls epistemological vandalism. As for the relation between psychology and adult education, the former is an esential source of knowledge for the latter. As studies in adult education use knowledge of sources outside this area it is necessary to draw attention to the constraints inherent in the original sources and disciplines.

I am not denying the presence of boundaries between psychology and epistemology. However, when dealing with the development of behaviour and mental mechanisms and, above all, with their very formation, one is constantly and absolutely forced to decide what depends on the object, what on the activities of the subject and what on the characteristics of the interactions between subjects and objects.

> Now, whether we like it or not, we are here faced with epistemological problems and , if we don´t want to work in the dark or to remain dependent on naive epistemology, the first responsibility of genetic psychologists is to keep informed

> of epistemological solutions and to check them against the data they collect (Kitchener 1986, 3)[20].

The joint treatment of epistemological-psychological issues is not an exclusive matter for genetic psychologists; I see it as an imperative when developing studies linked with educational practices. The possibility of transference from psychological explanations to educational practices probably constitutes one of the most problematic issues. Certainly the assessment of this problem needs interdisciplinary cooperation and consequently the clarification of essential concepts underlying each single disciplinary interpretation.[21]

Studies concerned with the interrelationship between culture and cognition have already shown the impossibility of explaining the knowing processes divorced from contextual influences. However differences arise to different degrees in the possible knowledge-transference from context to context (see Nunes 1992) and on the status given to the knowledge in different settings (see Biggs 1992a, 31-8; Biggs 1992b, 278). Behind these studies and results underlie psychological traditions i.e. Piagetian and Vygotskian traditions, which stress either the universal cognitive or sociocultural situatedness of cognitive actions. Therefore I ask myself whether these premises are essentially contradictory or whether the contradictions which create obstacles to integrate further development are rooted in particular sociohistorical psychological traditions. The problem is as Wertsch describes it, to achieve a proper balance between the universal and the particular.

---

[20] This is a translation presented by Kitchener, from *Autobiographie*. In *Jean Piaget -Werk und Wirkung, Munich: Kindler P.(15-59)*

[21] For a thorough analysis of this aspect see: Wertsch 1991; Kitchener 1986; Castorina 1993. As to the methodological implications of disciplinary and interdisciplinary approaches see Jacob 1992; Masingila 1994.

> This focus on the sociocultural situatedness of mediated action does not mean that there is no room for universals: I believe that universals exist and that they will play an important role. It stems from a belief that the universalism that has come to dominate so much of contemporary psychology makes it extremely difficult to deal in a serious, theoretically motivated way with human action in context (Wertsch 1991, 18).

Mediating all this debate some psychologists try to assume an intermediary position gaining the advantages of different perspectives (Saxe 1991; Nunes 1993). Both are important, universals and context-based processes. In principle I favour intermediary positions while indicating the need to clarify epistemic-psychological interpretations for conducting studies. In addition these are levels integral to the pedagogical level when psychological research is meant to foster educational practices or didactic research.

I shall analyze empiricism and constructivism on each of these levels, disregarding other interpretations such as the innatist or apriorist. This is the way Piaget himself has developed his theory, that is, by offering a tertiary alternative of interpretation to apriorism and empiricism. The confrontation between empiricism and constructivism helps to clarify my position rooted in a constructivist approach to knowledge. Consequently I shall draw special attention to constructivist explanations.

As pointed out previously, the mixture of these two models in some aspects of the *Educación Popular* in Latin America motivated the present study. Mainly, I have identified problems when basic epistemological and psychological definitions meet obstacles in the complexity of educational practice. On this issue I assume that psychological research aiming to provide tools for educational practices requires a constant matching between epistemology and psychology.

Within constructivism, I adopt the lines of Piagetian thinking through genetic epistemology and psychology, within the framework of empiricism. I shall refer in a broad sense to behaviourist theories.

2.3.1 Epistemological level

The position confronting reality has opened the channels to different ways of understanding and formulating questions about knowledge as the subsequent answers. The classical theories of knowledge originally posed some questions: what is knowledge? How can there be different types of knowledge? Then, the way questions about knowledge were formulated constituted in itself a distinctive feature, separate from the processes of constituting knowledge.

A very general answer, applying epistemological empiricism, would be that the subject of knowledge is determined by the object of knowledge. Empiricism´s conception of the subject experiences and the subject actions is explained independently of the subject of knowledge.

> On the one hand, it tends to consider experience as imposing itself without the subject's having to organize it, that is to say, as impressing itself directly on the organism without activity of the subject being necessary to constitute it. On the other hand, and as a result, empiricism regards experience as existing by itself and either owing its value to a system of external ready-made "things" and of given relations between those things (meta-physical empiricism), or consisting in a system of self-sufficient habits and associations (phenomenalism) (Piaget 1936/63, 362).

According to this position, knowledge is understood as a fact that does not admit contradictions and remains immutable. It may be studied and analyzed in a static form. In the field of the social sciences, the most evident consequences, and perhaps the most difficult to face are those of empiricism. It acquires force with Comte in his eagerness to explain the social order creating the Social Physics (Comte 1973, 48) and applying the reasoning procedures of natural sciences. Comte´s explanations were sustained in the idea of the existence of a natural logic of immutable character and applicable to all the domains of reality.

The reality and the evolution of scientific knowledge required a change in the direction of the form of thinking. It became very difficult to sustain the immutability of the known facts. In the field of physics, certain principles changed their form and contents, losing the stability they had possessed until then. That is the case of Einstein's theory in relation to the classical physics of Newton. The ideas that governed until that time, based on the conception of absolute objectivity, for example the invariation of time or matter, were questioned by the relativist conception. Then time and matter were no longer appearing as invariant, but dependent on the frame of reference in which they were being observed.[22] Despite the discussion of whether Einstein's observing subject may be interpreted as an epistemological change or not, I refer to quantum theory.

---

[22] Even though the revolutionary feature of Einstein's theory is still being discussed from the epistemological point of view, the concept of observing subject at least introduces the discussion of absolute objectivity. "Today Einstein´s fundamental revisions of physical thought have become so universally accepted that it is difficult to imagine how radical they once were. [...] Wholly apart from our opinion about the details of Einstein´s restricted and general theories of relativity he wrote, " there can be no doubt that through these theories physics is permanently changed" (Cohen 1985, 614).

> For, if we are changing the object in knowing it, how can we show that what we have is really knowledge of the object? This is perfectly analogous to what happens on the quantum level of physics when the physicist's observation of an electron (its momentum or position) transforms the electron by changing its momentum or position. In short, if knowing the object transforms it, how can we have objective knowledge of it as it is (rather than as it was)? (Kitchener 1986, 110).

A new relation between the subject and object of knowledge began to be considered. No longer would the determination of the object depend on the subject of knowledge as in empiricism, nor would the determination of the subject depend on the object as in apriorism, but rather on a dialectical interaction between the subject and the object of knowledge. This new relation between the subject and object of knowledge seems to answer the question: How should epistemological constructivism be characterized in general terms?

Therefore, the origin of knowledge does not reside in the objects, or in the subject, but in the interactions between the mentioned subject and the mentioned objects (Piaget 1970/85). This mode of understanding the interrelationship between the subject and object of knowledge should be seen as the interactionist thesis in terms of Piagetian theory.

From this perspective, knowledge as a process implies knowledge in progress. That is, passing from minor knowledge to a more complete and efficient stage. What is important, then, is to know about this progress.[23] Thus, this progress is produced from the action. It is right here where the relation between the subject and object of knowledge is being presented. But this action is not just any internalized action, that is confused with a manifest action. It is an internalized action that transforms the subject and the object from the dialectical interaction they maintain. Interiorization and internalization are words interchangeably used while meaning internalization by anglophone writers. Piaget commonly uses the one French word *intériorisation* for both. Interiorization would lead from practical to operational intelligence. Instead internalization leads to internal symbols to be differentiated from interiorization (Furth 1969, 262).[24]

---

[23] This might be a way to express Piagetian genetic constructivism. See Kitchener 1986.

Another characteristic is that the action is a transformer because of the processes of assimilation and accommodation involved in the interaction. The object is transformed by the subject through the meaning the latter gives it. Meanwhile, the subject - its action schemes[25] - is transformed by the object, when its characteristics present obstacles to be assimilated (Lenzi 1989).

Piaget states that knowledge does not arise only from the sensation or from the perception, but from the totality of the action. In other words the role of intelligence is not to contemplate but to transform.

---

[24] I will use internalization to refer to both senses throughout the text following Furth's explanations.

[25] I will not differentiate between scheme and schema throughout the text. I will use scheme for both as I do not use such differenciation for the empirical analysis. A scheme is the structure or organization of actions as they are transferred or generalized by repetition or analogous circumstances (Piaget & Inhelder 1966/69). "Scheme" does not include the particulars of the action or objects while "schema" includes the particulars of the objects as a consequence of its assimilation by a scheme of action. "The use of a scheme results in the development of a schema of the object to which the scheme is applied" (Nunes & Schliemann & Carraher 1993, 138).

> We only know an object by acting on it and transforming it (in the same manner that an organism reacts to a milieu by assimilating it, in the widest sense of the word). And thus there are two ways of transforming the object we wish to know. One consists in modifying its positions, its movements, or its characteristics in order to explore its nature; this is action known as physical.The other consists in enriching the object with characteristics or previous relationships which retain its characteristics or previous relationships, yet completing them by systems of classifications, numerical order, measure, and so forth: these actions are known as logical-mathematical (Piaget 1957/71, 61).

Following the line of analysis presented by Lenzi (1989) Piagetian epistemology could be characterized as a theory based on three central theses: interactionism, constructivism and the process of equilibration as an explicative process of the two previous theses. The assimilatory nature of all knowledge demands the cognitive development as an interactive and constructive process between developing subjects and reality[26]. Assimilation and accomodation refer to a single process. Assimilation relates the subject and object of knowledge. Objects of reality constitute the contents of the actions developed by the subjects from her/his existing structures. When the contents are new the assimilatory structure is modified by means of accommodation. That is, differentiation in accordance with the object to be assimilated.

---

[26] I see the Piagetian position as a critical realism. His theses can be seen neither as pure realism nor as idealism. It is difficult to return to Piaget's work to elucidate this theme because he is unclear on this point. However I suggest see Kitchener 1986, 104-111; Castorina 1989, 37-45.

Through accommodation general structures are applied to particular situations or states of reality.[27]

These relations or processes do not take place in an isolated form between one subject and one object, but they occur in specific social practices. Here it is worthwhile to stop and analyze this particular aspect, which has been the target of critics of Piagetian Genetic Epistemology and Psychology theory (Castorina 1984, 63-81). Though genetic psychology formulated the epistemological thesis of universal cognition, Piaget himself, faced with the evidence provided by intercultural studies[28], formulated a new hypothesis: that individuals reach the formal level, but in different domains, depending on their aptitudes and professional specialization.

Different intercultural studies have shown that the same basic notion would seem to be constituted in different cultural contexts but with different rhythms. An analysis of the interdisciplinary approaches to culture, context and cognition shows how the studies developed by Cole, Gay and colleagues, as pioneers in this field, conclude that cultural differences reside more in the situations to which particular cognitive processes are applied than in the presence of a process in one cultural group and its absence in another (Jacob 1992).

---

[27] Assimilation: "...the incorporating process of an operative action. A taking in of the environmental data (not mechanically) as a function of an internal structure. Accommodation: (...) the outgoing process of an operative action oriented towards some particular state of reality" (Furth 1969, 260).

[28] Lloyd (1983, 27) distingushes three different periods of Piagetian-inspired cross-cultural research. First, anthropologists and psychologists interviewed children and adults in primitive cultures to learn the nature of their thought. Second, cross-cultural evidence was sought to verify the universality of the structures and functions Piaget had described in his account of the ontogenesis of congnition. Third, psychologists became preoccupied with methodology and the need to delineate more fully the consequences of cultural diversity.

It would seem that the constructive mechanisms are invariant but that the developmental sequence may change. Therefore, a particular social practice may or may not signify a knowing object, and consequently alter the process of knowledge construction.

There is no possibility of assimilating pure objects. Instead, what is assimilated are the situations in which the objects play certain roles. Otherwise the situations are generated by the social environment. Piaget & García (1982, 228) analyze that what still remains for Genetic Epistemology is to explain how assimilation is affected by the social net of significations; and to what extent the interpretation of each particular experience depends on it.

> That the attention of the subjects is directed toward certain objects (or situations) and not others; that the objects are placed in certain contexts and not others: that the actions on the objects would be directed in certain form and not in others; is strongly influenced by the social and cultural environment (or what we call the social paradigm) (Piaget & García 1982, 245).

There are two main features to point out in relation to the Piagetian approach to the environment. First, the environment is not something that meaninglessly happens to individuals. On the contrary the environment is somehow created by seeking out those features to which individuals can meaningfully respond by assimilation and accomodation. Second, the environment is non-specific. Individuals do not need jars of water or clay balls to learn conservation. Materials are everywhere and individuals see what they can draw from them.

It is here that I find an epistemological reason for focusing my study on the workplace of adult subjects. The social-cultural characteristics of the sector in question lead to a concentration on work practices as propitious contexts in which to view the construction of knowledge. The specific work practice the subjects develop determines the type of constructive interaction with the environment. Let us look at some examples.

In a study in Colombia (Mariño 1978), the spontaneous forms of operating mathematically are systematized. Even though the sample of investigation is not characterized, it undoubtedly involves non-schooled subjects. What is shown in this study are the strategies utilized for solving operations e.g. addition, subtraction, multiplication and division. It clearly appears that the strategies shown are rather different from school or conventional algorithms.

One of the points of interest in this study is the reading one can make of the link existing between particular contexts and types of strategies developed by the subjects for operating mathematically. Perhaps where it is put in evidence most clearly is in the type of measurement systems they use on the Atlantic coast of Colombia. However, I am interested in the types of knowledge involved in specific labour practices and the problem situations that appear to facilitate the construction of new knowledge in such practices.

Mariño (1978) carried out a study with adults, investigating the particular modes of operating mathematically. He demonstrated, for example, the relation between the numeration basis used and different types of elements. On the Atlantic coast of the *Departamento de Córdoba*, people operate in the following manner when counting bananas: as 5 bananas go in one hand the basic unit of counting is 5. Thus, to add 8 + 3 they proceed as follows:

8 = one hand + 3 bananas
8 + 3 = (one hand + 3) + 3
8 + 3 = one hand + (3 + 3)
3 + 3 = one hand + 1 banana
8 + 3 = one hand + (one hand + 1)
8 + 3 = two hands + 1 banana

This means that those people tend to group things in groups of 5 elements; that is why 53 elements would be written: 10 hands and 3 bananas.

If we revert to Santander, we find that the artisans who make sacks operate with pairs of sacks (two pairs), due to the fact that with one hand they can take precisely 4 sacks. In this system, 9 + 4 would be counted as follows:

9 = 2 pairs + 1 sack
4 = a pair
9 + 4 = (2 pairs + 1) + 1 pair
9 + 4 = (2 pairs + 1 pair) + 1
9 + 4 = 3 pairs + 1 sack

Another example appears in relation to the systems of measures. In the *Departamento de Bolivar*, a measure of length called the *parada*[29] is very widespread, and it is used to assign work to a worker.

---

[29] From the Spanish verb *parar* = to stand up.

The *parada* is equivalent to the height of a man standing upright with his arm extended upwards (in the metric system, this would correspond to approximately two and half meters). As one *parada* is very short and it would become very slow to measure with it, there is the *palo*[30], that is equivalent to two *paradas*.

The system reaches much more elaborate levels, which include measures of surfaces. The first one of these is the *tarea*[31]. One *tarea* is equal to a rectangle of 5 *palos* in length by two *palos* in width; to 10 square *palos*. Apart from the *tarea* the system contains the following measures:

cuarterón[32] = *1/2 tarea*
cabuya[33] = *1/2 cuarterón*

These kinds of situations show the relation between the specific work-related practice that a subject is developing and the constitution of knowledge. This applies, particularly to those subjects who have not participated in school practices or have done so for a short period of time during their childhood.

2.3.2 Psychological level

---

[30] *Palo* = pole.

[31] *Tarea* = task.

[32] *Cuarterón* = quadroon.

[33] Caribbean word for Pita fibre of which cords and fabrics are woven. *Diccionario de la Lengua Española* of the Royal Academy of Spain.

The theoretical considerations presented in the epistemological level permit me to observe the derivations, i.e. the explicative coherence, that I find on the one hand, in the behaviourist psychological theories, and on the other hand, in the psychogenetic.

A long tradition exists in the investigations of learning that combine a behaviourist psychology with epistemological empiricism. With reference to the idea of the sensory origin of knowledge, the place that remains for the knowing subject, from the psychological point of view, is that of a passive receptor of the impressions of reality. The subject's participation in the construction of knowledge is limited to the direct registering of experience. The cognitive activity is exclusively reduced to the level of sensation.

Learning for behaviourists is a process directed from the outside. If the experiment is efficiently controlled, e.g. temporal ordering and the repetition of the stimuli, and if the external stimuli are correctly administrated, one can create new associations in the learner (Castorina 1984).

Thus, learning is produced through the stimuli-responses making possible an associating activity by the subject. There is a linear process between the stimuli and the responses. Behaviourism sees the subject intervening just with her/his sensory capacity. Thus, s/he reacts to the provocation of a particular external stimulus, but with no influence from previous learning. The subject is at point zero in facing the new learning. (Lenzi 1985)

Within behaviourism I would refer to Watson (1878-1958) as the leading theoretician, even though Thorndike began these studies with the first laboratory of zoo psychology.

> Watson subsequently took the Pavlovian model (as interpreted by the behaviourists) as the basis of his experimental programme. [...] He was pursuing his idea that the behaviour of all living creatures was subject to the same laws, therefore the human being also could be interpreted as a "stimulus-reaction" machine. He paired off a neutral stimulus (say, the sight of the rabbit) with a basic emotion (fear), and demonstrated that this stimulus (or even one resembling it) would by itself come to evoke the given affect. Experiments were made with infants (fear being induced by a loud noise or apparent withdrawal of support) (Yaroshevsky 1990, 279-80).

Reference should also be made to neobehaviourism. Skinner, one of its representatives, developed the model of operant conditioning. In this case, only the desired responses are reinforced for the purpose of eliminating those not desired. This model shows that the organism in which new responses are expected to be generated, does not always respond appropriately, and that is why a selective reinforcement must exist. This creates evidence, in one way or another, that something beyond the externally observable occurs in the interior of this organism. I should mention the experimental box created by Skinner for studying operant behaviour. It later constituted an important basis for programmed learning and educational-technology development.

Even though these experiments were carried out with animals, they were generalized, as explanations to the field of human conduct creating a real explosion of educational technology and behaviour therapy. It is clear that a profound coherence exists with what happened and with empiricism at the epistemological level.

Finally, I could say that this conception or explicative frame of learning is structured on two basic conditions:

a) The acquisition of knowledge occurs in a sequenced form and as a function of the sole experience.
b) Knowledge is constituted in fact-products that are registered in an immediate form through perception.

It would seem that the idea of the inactiveness of the psychological subject who only reacts when faced with external stimuli is also coherent with the epistemic subject of empiricism.

Let us now look at what genetic psychology has to offer from another epistemological paradigm. The investigations carried out from this theoretical perspective questioned precisely behaviourism itself in the two conditions mentioned above. The results of further investigations were conclusive. The perception, for example, is not reduced to the perceptual image, but involves a systematic activity, that permits reconstruction of the perceptual image and grants it objectivity. In the same way the reading of an experimental physical fact supposes a structuring activity of the data by the subject. More precisely, the experience is only accessible through the logic-mathematical tables, that consist of classifications, orderings, correspondences, functions (Castorina 1984, 19).

For genetic psychology, the subject develops an activity, in action or internalized. There is a processing of the stimuli, generating a relation of assimilation between stimuli and responses. The subject does not carry out a direct reading of the experience. On the contrary, this is always performed from the schemes of assimilation that s/he possesses.

In the case of the action being internalized, anticipations are made in relation with the object. The stimuli are not considered as something external that has nothing to do with the subject. But the subject creates a hierarchy of the stimuli, granting them significance. From the psychological point of view, the stimuli are significant facts. They only become significant when there is a structure that permits their assimilation, a structure that can integrate this stimulus, but at the same time responds. Without schemes of action, without an organizing activity of the reality, the facts are not significant for the subject (Castorina 1984).

The stimuli are constituted as such for a subject, when the subject her/himself recognizes them as such through the signification s/he grants to them. Piaget explains that learning by experience does not occur from pressures passively suffered by the subject, but from the accommodation of her/his schemes of assimilation. The starting point of all knowledge is constituted by a certain equilibrium between the assimilation of the objects to the activity of the subject and the accommodation of this activity to the objects. Knowledge is presented from its very beginning in the complex form between the subject and the objects, excluding any interpretation purely empiristic or purely aprioristic of the cognitive mechanism (Piaget 1970/1985).

It would be worthwhile at this point to analyze more profoundly what it implies for the psychogenetic theory to speak of learning, and what differences Piaget establishes between learning in a strict sense and development and learning in a broad sense.

Learning in general terms might be defined by the growth of the knowing structures. However not all learning fits with this definition. Furth (1969, 221) states that is not the same to learn the name of a capital as to learn the temporal succession i.e. the tomorrow that is today will be called yesterday. Learning the vocabulary in the case of the name of a capital does not occur in the same manner as comprehension of temporal succession.

> The learning of Bern as the capital of Switzerland seems incomparably less important than the capacity to understand what the terms mean. Or rather, these are not things that can be compared with each other. It is like asking what is more important for sustaining life, food or the earth (Furth 1969, 221).[34]

This example seems to lead towards the differentiation between that learning through which specific information is acquired from the environment as confronted with other learning which produces the progress of knowing structures due to equilibration processes. (Pozo, 1989)

> A new scheme is the product of learning in the strict sense, insofar as it results from the differentiation of a previous scheme and insofar as this differentiation involves an accommodation that depends on experience. But for this learning to take place there must exist previous schemes that can be differentiated during assimilation of new objects. Moreover, the structure of these schemes and the assimilation, considered strictly as the prerequisite of the structure, are preconditions and not products of learning. [...] What is learned in strict sense is the differentiations due to accommodation as the source of new schemes vis-à-vis the increasing diversity of contents. **But what is not learned in**

---

[34] I also find it important to remark on how Piaget restricted the notion of learning "to an acquisition of new knowledge that derives primarily from contact with the physical or social environment. He contrasts it on the one hand to maturation which is based on physiological processes; on the other hand and most importantly he differentiates it from the acquisition of general knowledge or intelligence which he defines as the slowly developing sum total of action coordinations available to an organism at a given stage. This general knowledge [...] is actively constructed by the person who in constructing this knowledge lives the process of his development" (Furth 1969, 221)

> **strict sense is the assimilative activity with its consequence of an equilibration between assimilation and accommodation**[35] (Furth, 1969, 236). [Bold is mine]

Learning in a strict sense would become subordinated to the development of the general knowing structures. That is, in the learning process logical elements intervene that have their origin in the general mechanisms of development and that have not been learned solely by experience. Results obtained by Piaget and colleagues show that it is possible to facilitate the acquisition of notions or operations by learning sessions. This is important in depicting any hereditary or maturationist interpretation.[36]

In terms of the possible interactions within the given situations, we may say that not any interaction the subject performs will produce learning in the strict sense. The intervention of an external situation upon the subject should exist (Castorina, 1984, 21), though Piaget does not clearly state that this kind of learning in a strict sense requires the intention to provoke it. It seems to me that this comes about when Piaget states that learning is provoked by situations like a psychological experiment, or by a teacher in respect of a certain didactic theme, or by an external situation. Furthermore, it is a process limited to one sole structure or to one sole problem (Piaget 1964/67, 176). If it were so, this would be a key concept in relation to pedagogical intervention.

---

[35] This is a translation from Piaget "*Apprentissage et connaissance*" in *Études d'épistemologie génétique*, VII, (21-67). Paris: *Presses Universitaires de France*, 1959. Translated by Hans G. Furth, by permission of the publishers.

[36] For further analysis on development and learning see Coll & Marti 1990; Pozo 1989.

Let us now observe cognitive development through the theory of equilibration. As it was stated above, the starting point of every process is the equilibrium between the assimilation of the objects to the activity of the subject and the accommodation of this activity to the objects. That is, the action of the subject implies an accommodation to the previous schemes. Many times these schemes and actions find external inconsistencies that provoke a cognitive disequilibrium that in turn needs a new reequilibration. To reach the new state of equilibrium, it is necessary to verify changes in previous schemes. The new schemes will be in consonance with the previous ones, but they should lead to a knowledge, in a certain sense, more in accordance with reality.

Coll (1981, 159) describes the process of the scheme modification stating that what leads a subject to renounce one (of her/his schemes) in favour of the following one, is that her/his cognitive assimilation experiences difficulties. These come about when coming into conflict with facts, beliefs or what other people say, and the like.

The general reason both for applying a scheme once it is possessed, and elaborating new schemes in the course of development, would reside in the necessity to make sense of the present problems, adapting them coherently to the schemes used in previous solutions.

Recalling now either differences or accomplishments between learning, in a strict and in a broad sense, and development, Piaget tells us that "...the interactions between assimilation and accommodation imply therefore two factors, learning in the strict sense and equilibration. These two factors underlying the functional process in its totality can be called learning in the broad sense and are practically identical with development" (Furth 1969, 236).

I consider it important to include these distinctions, on the one hand, because it permits me to open new questions regarding the relationship of contexts and the constitution of knowledge, and on the other hand, understanding this distinction is of fundamental importance through the consequences derived from it on the pedagogical level.

Frequently Piaget has been misinterpreted or simply not interpreted at all, thus denying the possibility of pedagogical intervention in the frame of psychogenetic theory. This kind of interpretation indicates that the idea of learning, in a strict sense, has not been understood, which clearly indicates that for learning to exist in a strict sense there must be a provocation of the learning.

Though Piaget himself often made clear that he was not concerned with education but with epistemology, his ideas were rapidly and worryingly disseminated in education, producing many critics of Piagetian theory. This generally focused on the incorrect transferences of Piaget to education and rarely on the theory Piaget developed.[37] It is impossible to label any educational method as the method of Piaget. What Piagetian psychological studies have provided is a new perspective for teachers to understand children's thinking. But indeed this is only a prelude to the development of new educational means (Gruber & Vonèche 1977, 691).

It can be said that even if learning depends on the structural levels of development, this acts merely as a backdrop to the learning process. This backdrop puts a limit on the stage at which particular problems are presented to the subject, which s/he solves through the unfolding of different action strategies.

---

[37] For this kind of unfortunate critic see Boyle 1983; Sants 1983

These choices made by the subject in the process of solving a problem imply some representation or idea of what to solve and, to a certain extent, of how to solve it, though the how of the solution is being defined by the subject in the action itself, from the successes or failures reached. Meanwhile, the what would be previously defined by the subject and therefore orientates the searching.

When analyzing the constructive role of errors in the acquisition of knowledge, Castorina & Lenzi & Fernandez (1984), regarding the subordination of actions to the structural level, state that the solution of the task involves *procedures* the child [or adult] elects to use in order to try to achieve success. This is to say, that the set of possibilities given by the structural level is not sufficient because between them and the child [or adult], s/he has to *actualize* some of them in relation to the proposed objective. In the course of the procedures directed to reach the success of the objective, s/he uses some alternatives, later s/he abandons them for others, without each sequence of actions being known by her/him in the beginning of the task. S/he goes on electing every sequence of actions, substituting the previously adopted ones until s/he creates the solution (Castorina 1984, 47). The sequences of actions displayed for the solution of a problem vary from one subject to another, according to the social setting where the situation is presented and to the subject´s background.

Examining a study carried out in Brazil (Schliemann 1988, 173), in which performance is compared between carpenters who learnt the profession informally and others who had participated in different types of formal courses in order to learn the profession, we can observe how, when confronted with the presentation of a problem situation, different solution strategies appear.

At this point I shall only go through the strategies used by the group of carpenters who possess informal learning of the profession. The sample constituted of 13 subjects, whose ages ranged from 14 to 18 years, with different levels of school experience. The problem consisted of calculating how much timber was to be bought to construct 5 beds according to a sketch given to the carpenters. The results of the strategies used were classified in three categories:

a) Mental calculations: when the subject presented the answer directly without using pen and paper.

b) School algorithms: when pen and paper were used, and the answers were found operating in the first place with units, after that with tens and then with hundreds, etc., always carrying numbers from one column to another, when it was necessary.

c) Mixed strategies: when the mental calculation was used for operating with small numbers and the school algorithms with bigger numbers.

Finally, of all the subjects, three used mental calculation for the solution, nine mixed strategies and only one used school algorithms. The sequences of action followed by every group of subjects do not appear in this study, but it is evident that every group used different means. Even though they are few in number, some interesting studies do exist in which the use of particular strategies is evidenced for problem solving.

The theoretical interpretative framework that I found in genetic psychology, leads to the search for empirical evidence about the particular knowledge that the non-schooled subjects have of their reality and of how they approach it. In other words, this refers to the learning processes that they experience in their everyday life. Thus it is important for my study to investigate the subject's work-related practices.

2.3.3 The level of pedagogical interventions

I have tried to analyze, on the epistemological and psychological levels, the existing link between empiricism and behaviourism regarding learning, on the one hand, and genetic epistemology and psychogenetic theory, on the other. Even though it is not my aim to make a deep analysis of what is happening on the pedagogical level, it seems important to me to point out some questions and to give an example related to adult education.

I shall not analyze any particular case related to the use of Piagetian ideas in education. Rather I shall refer on this level to the general conditions under which the present study arose. The examples I will present do not fit exactly into any pedagogical theory but shed some light on the actual conditions under which adult educational practices run in the particular context where the study was carried out.

At the root of both the behaviouristic and the psychogenetic theory, pedagogical intervention is considered to provoke learning. But the differences between both theories appear in the modes that this intervention adopts. Thus, different positions emerge related to the participants' role in the pedagogical relation. It is in the relation established between the learner, the teacher and the object of knowledge where fundamental differences are to be found. In the following I shall synthesize the behaviourist theory and the psychogenetic theory in each of the components of the triad.

> a) Knowledge is a ready product, easily systematized, allowing neither approximations nor anticipations; or on the contrary,

social constructions are dealt with that admit different levels of approximation or reconstruction.

b) The subject does not possess any kind of representation or spontaneous theory about the knowledge presented to him/her, does not know anything about it; or on the contrary, s/he grants a particular signification to the knowledge, and possesses some level of previous construction of it connected to the possibilities of interaction that s/he has had.

c) The intervention of the teacher is planned and performed independently of the learner, presenting the content, practising and then evaluating the product. Or on the contrary, the teacher presents situations that may problematize the subject in respect to some particular knowledge, knows the levels of construction of the learner for intervening by generating conflicts leading her/him to greater or more complete levels of construction by evaluating the constructive process.

Some observations in schools for adults

Within the frame of the general project *Adults in schooling situations: an approach to their reality* (Villar 1991) I have observed some classes. Some interesting episodes were registered providing evidence of the interplay of these elements, and in some way reporting the learning assumptions that orientate activity in the classroom.[38]

---

[38] In Appendix 5 I present the abstract of the study *Adults in Schooling Situation: an approach to their reality.*

Behaviourist assumptions appear to govern the relations in the classroom. Then there is practically no room for the activity of the student. The teacher orientates, step by step, the development of the tasks proposed. The repetition of the same task seems to constitute for the teacher a resource for guaranteeing learning. There are some situations in which the teacher tries to use different resources for organizing the activity, for example, working in small groups. However, this does not essentially modify the didactic situation.

An example extracted from one of the observations carried out in a school for adults may offer an idea of the organization of tasks in the classroom

Excerpt 1. The observation was carried out by two observers in a group of beginners of a State school for adults.

An observer approaches two students who are working with a reading book.
The reading book shows two drawings of a baby and a drawing of a family together with a word "I" (I am).

A student copies in his copybook: I, I, I, I,......
Teacher to the student: Copy I,I,I,I,...for learning. Copy the drawing so that it comes out well, practice!

The copy of a model given by the teacher seems to be a central resource for the student's activity. The student has to repeat as many times as it is necessary until it comes out correctly. This mechanistic repetition is understood as the way to reach the correct outcome of learning. Therefore, learning is seen as a product and not as a process. Certainly, this is not what the same teacher says in the interviews, on the contrary, teachers stress the constructive character of knowledge and the activeness of the students. However, the practice becomes contradictory and militates against the possibility of constructive activity on the part of the students.

As for the materials used for presenting the models, they are not even adaptations of children's materials but meaningless in contents and tasks. The use of models in principle is not bad. The problem resides in what the models convey and the kind of activity they produce.

Excerpt 2. (Idem excerpt 1)

Teacher to a student: Let's read.
Students: I know it all, but I can't get it out.
Teacher: Did you become nervous?
Student: The E with the N...(shuts up)
Teacher: read this letter (points out the E)
Student: E with N. ***En****.*
(Goes on decoding, but, in general, the teacher says the word once "B" recognizes the letters.)
Teacher: Very well. In this classroom everybody knows how to read. If somebody says they don't, that's a lie.
Student to an observer: It seems to be easy and how difficult it really is.

The student states s/he knows it but cannot actually say it. The teacher's answer is to justify the student's failure by the student's nervousness. The student says that s/he knows it all but unfortunately is not asked to tell what s/he thinks s/he knows. It seems that it is not relevant to the teacher what the student knows but rather what the teacher wants the student to know.

At the end of the excerpt the teacher tries to stimulate the students by saying that everyone reads. Actually the teacher is defining a state of the learning process which is far from true. Instead the student recognizes the difficulty of reading.

Excerpt 3. (Idem excerpt 1)

The teacher gives the following card to a student:
Indicate what comes before and what comes after:

1001 8508
1999 6053
5007 8102

Teacher to the student: What comes after three?
Student: (after a while), four.
Teacher: Very good. Before 1001...to get the number before, you subtract.
Student: A thousand.
Teacher: what do I do to get the next number?
(The student doesn't answer.)
Teacher: Here you add it. That gives me 1002.
Teacher: From the previous number I take away one, to the following one I add one.
Teacher: If you have any question, call me.
(The student works alone and in silence.)
(For a while the student continues looking at the notebook but doesn't write anything. He holds his head in his hands.)
The teacher approaches the student, who shows her the copy book.
Student: is it OK?
Teacher: No. From the number I take away one, I subtract. After that I add one to it. Ask me, don't fall asleep.
The teacher goes to work with other students.
(After a while)
The teacher approaches the student: How tricky you really are (the teacher laughs), like that you work less.
(The student didn't make written accounts of the addition and subtraction, but subtracted and added the units mentally.)

BEST COPY AVAILABLE

What emerges in each of these examples is a pedagogical relation in which the teacher organizes and directs the process independently from the learning subject. The teacher anticipates the answers in order to avoid errors. When the teacher does not succeed and the errors appear, s/he corrects them without analyzing them. Then s/he gives the desired answer before the students have reflected on the errors.

On the other hand, there is no space for any particular strategies on the part of the students, even if they might be correct, because these strategies are not the ones desired by the teacher. Mental calculation is not only undervalued but the teacher considers it as a trick.

What the students might know or interpret about study themes is not considered. On the contrary, the "school criteria" are being imposed by a set of stereotyped answers that both the teacher and the students are expecting to obtain from each other. Doubtless, this is connected to a long pedagogical tradition of behaviourist methodologies that in one way define the system of relations in the classroom and place limits on the possibilities of learning.

It is difficult to see the interactive and constructive character of knowledge in a pedagogical relation such as the excerpts show. However I understand that the origin of this absence cannot be looked for only in an actual educational situation. Answers must be looked for in the integral relationship of epistemological-psychological interpretations and their transference to education.

On the level of pedagogical interventions, it remains a great challenge to psychologists and educators to connect the previous knowledge of the subjects to what is being taught.

2.4 Summary

In this chapter I have presented a theoretical approach to the processes of knowledge constitution based on Piagetian epistemology and psychology. I have pointed out the fruitfulness of adressing Piagetian theory in the field of adult education psychological-epistemological issues.

In this regard, I emphasize the discontinuity verified between theoretical standpoints in the educational field and educational practices which I contextualized in the case of *Educación Popular*. However, discontinuities in the transferences of psychological research to education constitute a central issue in itself. The analysis of a particular case as proposed provides elements for the general discussion.

I have borrowed Piagetian thinking to analyze the processes of knowledge constitution. Therefore, I would sum up my theoretical position within the three central theses of Piagetian Epistemology: interactionism, constructivism and equilibration as their explicative process. Thus, I stress that the assimilating character of all knowledge presupposes cognitive development as an interactive and constructive process (Lenzi 1989).

In other words, disequilibrium plays a functional role of primary importance because it necessitates reequilibrations. Even the most elaborated science in any field of knowledge remains in progress (Piaget 1975/85, 139). Consequently, the idea of progress put forth by Piaget should be understood through the concept of *équilibration majorante*, but based on two conditions. The first is that optimizing equilibration is not reduced to a march toward static equilibrium. The second is that it is not seen in terms of a pure evolutionism leading into a radical becoming that forgets the mechanism of transmission and the fact that every improvement is orientated in the direction of coherence or more developed forms of internal necessity (Piaget 1975/85, 143).

I would like also to stress in this summary that interactions between subjects and objects do not occur free from social influences. On the contrary, they are influenced by the social net of signification. Therefore, work-related tasks cannot be understood while disregarding the constraints presented by the social practice in which they are placed. However, this does not mean that the processes of knowledge constitution are strictly bound to the social context.

In the following chapter I shall adress problem solving as a particular aspect of knowledge constitution in relation to the different contexts in which problem solving processes take place.

3 - PROBLEM SOLVING

There have been major developments in the field of problem solving research with children as well as adults. Problem situations are viewed as devices to examine individuals' cognitive activities. In the field of psychology problem solving has had diverse applications for understanding the functioning of the human mind. Within the context of behaviour theory on which are based the many American conceptions of learning, a particular technique for analyzing intellectual mechanisms has developed and is known as the problem-solving method. It consists in setting the subject a problem that is new to him and which may be of any level, ranging from sensorimotor intelligence to the higher thought processes (Gruber & Bonèche 1977, 347-8). Within the Piagetian tradition problem situations have also been used for assessing individuals' strategies or decisions taken in the course of the task-solution (Piaget 1975/85, 33; Inhelder & Sinclair & Bovet 1974, 271; Karmiloff-Smith 1984, 86). In the educational field problem solving has been applied and studied with different purposes (De Vega 1985, 493-514; Charnay 1987; Simon 1978). Information Processing Theory (Simon 1978) has had a major impact in education. The impact is probably connected with the strong influence received from artificial intelligence research.

Cole & Scribner (1974) have recognized quite a while ago the difficulties operating in the studies of problem solving. Three main reasons are identified to explain the discontinuity between interest and accomplishment when studying problem solving. First, there is an important sense in which psychologists and other social scientists are not talking about the same topics when they refer to culture, logic, and problem solving. Second, there really is no solid body of research on culture and problem solving using techniques and problems that psychologists view as legitimate, with the exception of the Piagetian research. Third, studies on this topic are very difficult to interpret even within familiar cultural contexts. The key here is that problem solving, in ways that are pervasive and compelling, is always seen as a component of a larger behavioural network in which perception, memory, classification, and all other cognitive processes play a role. Cole & Scribner (1974, 168-70) argued that it is virtually impossible to isolate problem solving as a "thing".

I find that the reasons stated by Cole & Scribner still apply today. However I disagree with the stated third reason. Problem solving in my view can be studied as such, as situations that differ from non-problem situations and this is a key point for educational design. Problem solving as a "thing" does not need to be isolated but integrated by identifying the constituents. Perhaps the central problem in studying problem situations as a particular issue are the methodological difficulties involved in obtaining empirical evidence. However the relevance of the theme calls for the struggle.

My research interest is in the analysis of the main elements which define the problem situation, the relations between them and their characteristics. The strategies and procedures involved in problem solving for explaining developmental aspects is not my concern, but rather the general characteristics of problem situations at work. I am approaching the questions related to problem formulation. It refers to instructional design or to the use of problems at the pedagogical level.

In addition in order to address the issue I try to understand from the subject´s point of view how they face everyday problem situations. This is intended to help rethink the present ways of designing problem situations. There aspects are raised which support this decision:

> a) there is no way to reassess the present ways of formulating problem situations ignoring subjects´experiences;
> b) in approaching everyday settings one approaches subjects´ natural ways of performing and therefore work-related activities are particularly relevant;
> d) understanding of how problem situations appear in everyday life for adult illiterates may provide elements for rethinking basic adult education from the instructional design point of view.

I shall present in this chapter some central aspects of the Piagetian explanation about the equilibration of cognitive structures. In Chapter 2 I have gone through the interactionist and constructivist theses of Piaget. The equilibration of cognitive structures comes to explain as well as to complete the former thesis. Finally I shall present different approaches in problem solving research.

3.1 Interactions and conflicts

In the analysis of interactions and conflicts I shall concentrate first on the role of perturbations and the different types of reactions from the equilibration point of view. Second, I shall explain what is meant by consciousness and abstraction in Piagetian terms.

As stated earlier with reference to the psychogenetic theory, a subject solves problems by unfolding sequences of actions according to the structural levels of development which act as a background for problem solving. Knowledge results in an interactive process between the subject and the object of knowledge by successive constructions producing new structures. Piaget states (1975/85, 25) that there is a dynamic process of equilibration and reequilibrations that correct and complete previous equilibria, i.e. *équilibrations majorantes*.[39] This concept refers to the idea of improvement or optimization of the equilibration processes. The equilibration processes are not a simple progression towards equilibrium in Piagetian terms, but they always involve a construction orientated towards a *better* equilibrium (Piaget 1975/85, 26).

The equilibration of cognitive structures constitute a central thesis in Piagetian theory. I shall explain the equilibration process, as it occurs in concrete interactions between subject and object by bringing out the concept of perturbations. In doing so I shall leave out the analysis of regulations and compensations, through which Piaget explains the how of the equilibration and reequilibration.[40]

Focusing on the subject's viewpoint, an assimilatory scheme confers meaning to the objects when assimilating them, as well as assigns goals to the actions when organizing them. In terms of practical success, it could be viewed as the manipulation of the working instruments and materials intervening in a given situation, e.g. shears, handsaw. In terms of representation, by establishing a relationship between the different intervening variables and the goal of the situation, for example, pruning to shape a three-year-old plant.

---

[39] I shall use the Piagetian term in French *équilibrations majorantes* without translation into English.

[40] For a deep analysis of regulations and compensations see points 5 and 6 in *The Problem and Some Explanatory Hypotheses* (Piaget 1975/85).

The subject faces a perturbation when anything creates obstacles for assimilating an object or achieving a goal. Therefore, perturbations may lead to regulations[41] or to equilibration. However, there are different kinds of perturbations. Piaget distinguishes two large classes.

> The first includes perturbations hindering accommodation - for example, objects' resistance to assimilation or obstacles to the reciprocal assimilation of schemes or subsystems. [...] The second class of perturbations consists, on the contrary, of lacunae that leave needs unsatisfied. These arise when elements necessary to the functioning of a scheme are lacking. [...] A lacuna becomes a perturbation when objects or conditions necessary to carry out an action are missing or when one lacks knowledge needed to solve a problem (Piaget 1975/85,16).

The idea of perturbation within the process of regulation might help to analyze the activity of a subject facing problem-solving processes. When speaking of lacunae, and more restrictively of those lacunae which produce perturbations-equilibrations, Piaget presents two different but related causes. Thus, it would be necessary to clarify what condition are necessary to carry out an action, or what knowledge is lacking to solve a problem. The latter might constitute a bottleneck in regarding the process of problem solving and the constitution of knowledge. Perturbation is only an obstacle holding assimilation in check. Piaget states that this is true whether it involves a fact contradicting a judgment or a situation hindering achievement of a goal (Piaget 1975/85, 145).

---

[41] Regulations constitute reactions to perturbations.

Studies conducted on the problem-solving of children show that change cannot be explained by failure or conflict alone, instead it is stated that conflict is sometimes the product of change and not the motor for it.

> Although negative feedback may indeed play a role for children in reaching an initial procedural success, it does not explain why they go beyond success. Neither is it that the success is fragile. On the contrary, we have seen here that it is the robustness and stability of the procedural success that seem to be the precondition for metaprocedural processes to initiate their operation of analysis and reorganization. What children are striving for, I would argue, is control both over the external environment and over their internal representations (Karmiloff-Smith 1984, 86).

Piaget states regarding the relation between positive and negative feedback that it is complementary. For example the formation of a habit involves positive and negative feedback. The latter appears in the necessary trial and error instances which involve negative feedback (Piaget 1985, 17). In any case perturbations and conflicts arise as fundamental factors for acquiring new structures of knowledge. This is not a theoretical speculation but empirically verified. (See Piaget 1975/85, 33; Inhelder & Sinclair & Bovet 1974, 271).

Piaget distinguishes different types of reactions[42] when analyzing the equilibration-reequilibration processes with relation to perturbations. He identifies three types of reactions: α; β;γ.

---

[42] Piaget speaks of "conducts", "reactions", "cancellations" and "compensations" of types alpha, beta and gamma. All the terms refer to the same phenomena (Piaget 1975/85) [note of the translator]. With respect to the term "conducts" Piaget uses instead the term behaviour generally in English versions because conducts sounds unnatural in English. But he makes clear that behaviour in his sense includes consciousness.

> **Reactions α:** When a new fact surfaces, it can, according to the case, produce no modification of the system at all, or it can produce a perturbation (Piaget 1975/85, 55).

An example of the first possibility would be when the new fact is only one more fact to be included in a classification system ready to subsume it. Examples of the latter include situations where a characteristic brought about by the situation contradicts a description the subject has given previously, where an unexpected object cannot be classified using a classification schema previously adopted by the subject, or where a relationship does not fit into the series of strategies that had proven adequate up until then.

Instead, when a perturbation comes about, the reequilibration produced in the wake of disequilibrium may take the form of a type α reaction. In these cases, Piaget distinguishes two varieties of reaction. The first is seen when only a minor perturbation is involved that does not move the system far from equilibrium. In such cases, reequilibration is achieved by the subject´s introducing a simple modification orientated in the direction opposite to the perturbation.

By contrast, the second form of type α reaction occurs when the perturbation is stronger, or is implicitly judged so by the subject. In that case he will cancel it out by ignoring or removing what bothers him.

> **Reactions β:** In contradistinction to type α reactions, the second type of reaction to perturbation has to do with integrating into the system the perturbing element that has sprung up externally (Piaget 1975/85, 56).

In this type of reaction compensation[43] involves changing the structure, a process referred to technically as a displacement of equilibrium. That is, what was a perturbation for the system becomes a variation within a reorganized structure, thanks to the establishment of new relationships that connect the element incorporated with those that were already organized. Compensations may acquire different forms, depending on the case: on the one hand, when objects encountered during the solving process cannot be assimilated into the scheme available, on the other hand, when events contradict the subjects' predictions. However, in both cases Piaget states that an analogous variety of compensations is found. Either the external event is denied to be perturbing (by overlooking it or sometimes even by support of repression) or schemes are modified (Piaget 1975/85, 22).

> **Reaction γ:** The next higher type of reaction, possible in all logicomathematical situations and in certain highly elaborated causal explanations, consists in anticipating possible variation (Piaget 1975/85, 57).

Because they are predictable or deducible, variations lose their character as perturbations and become instead potential transformations of the system. That is, subjects react in this way when, from the cognitive structure they possess, they can organize the task anticipating the effects of what would be the perturbing element.

---

[43] Compensations as reactions to perturbations constitute actions opposed to and tending to cancel or neutralize some effect.

Coming back to the role of perturbations in Piagetian explanations there are still some aspects to clarify. Szeminska[44] pointed out to Piaget that perturbations generally remain disregarded and unexplained when there are many perturbing elements and not just one. Piagetian explanations on this point focus on the role of cognitive repression in the same way Freud explains psychological repression[45]. However Szeminska is quite right on her point. In experimental situations the researcher tries to provoke perturbation until the child reacts and therefore activates the schemes. But how does this relate to the situation in everyday life where subjects also solve problem situations? What activates a scheme or perturbs the subject? The answer to this question is still open in Piagetian theory, but a way forward might be the analysis of routines in everyday life.

Another closely related issue regarding conflicts and interactions is consciousness. Piaget refers to consciousness as to cognizance. In general terms the process of consciousness is understood as the conceptualization of the situation. But the possibility of conceptualizing the situation does not change the situation even when a problem solver is aware of the mechanisms used to solve the problem.

---

[44] Alina Szeminska participated in a meeting organized by the Centre of Genetic Epistemology and Psychology in homage to Piaget's 80th years old. The discussions held in the meeting were published by García & Inhelder & Bonèche 1977.

[45] Piaget gives as example a child who has an action scheme, for instance to throw a ball against a box or other ball to move it. In this case the child always places the ball in a way that the motor ball reaches the passive ball. The researcher asks the child to hit the ball but just on one side. This possibility does not fit within the child's scheme, the first reaction is to reject the perturbation. But this rejection is not as in the case of affective repression. Here it is rather simple, the child sees the problem but s/he does not accept it (García & Inhelder & Vonèche, 1978, 164-65).

> In general when a psychologist speaks of a subject being conscious of a situation, he means that the subject is fully aware of it. The fact he has became aware of it neither modifies nor adds anything to the situation - all that has changed is that light has now been thrown on a hitherto, for him, obscure situation. (Piaget 1977, 332)

The act of becoming conscious is that by which an action scheme is transformed into a concept. Therefore cognizance could be interpreted as conceptualization. Piaget claims that if cognizance were just the throwing of light on the situation, there would not be need for new constructions because the necessary coordinations would have been already achieved at the level of the material actions.

Studies conducted by Piaget and his collaborators (see Piaget 1978b) have shown that the action in itself constitutes autonomous and already powerful knowledge. This affirmation is certainly important regarding the object of study of this work and it is also central to Piagetian theory.

> Two main hypotheses advanced in our earlier work were that action constitutes an autonomous form of knowledge (know-how) which is conceptualized by later, conscious assimilation, and that the latter proceed systematically from the periphery to the centre, that is, from accommodation zones to the object, ending up as internal co-ordinations of actions (Piaget 1978b, 213)

Piaget in his work the *Grasp of Consciousness* (1977, 347) explaining the "how" of cognizance states that even if just knowing how to do something, which is in fact knowledge, is not conscious in the sense of a conceptualized understanding, it nevertheless constitutes the latter´s source, since on almost every point cognizance lags, and often markedly so, behind the initial knowledge, which is thus of remarkable efficacy despite the lack of understanding. Subjects faced with problem situations do not establish any kind of frontiers between their practice and conceptual systems to explain it. For Piaget conceptualization supplies to action the reinforcement of its powers of anticipation and the possibility, in a given situation, of devising a plan for immediate implementation.

> In other words, its contribution is to increase the power of co-ordinantion already immanent in action, and this without the subject's establishing the frontiers between his practice (What must I do to succeed?) and his conceptual system (Why do things happen this way?). (Piaget 1978, 215)

The relation between these two interrelated aspects, practice and conceptual system, comes out as well in the concepts of empirical and reflexive abstraction. Empirical abstraction[46] refers to the information taken from the objects as such or from the material actions, that is, from the observables. Instead the reflexive abstraction refers to the coordinations of the actions on the objects. Both kind of abstractions exist at any level of development from the lowest stages to scientific thinking. However, there is a growing differentiation process from the lowest to the higher stages between both kind of abstractions. This growing differentiation occurs because in the sensorimotor stage the differences between actions and their coordinations (or form and content) is less clear. But still between empirical and reflexive abstractions there are two other forms of abstractions: pseudo-empirical abstraction and reflected abstraction (Piaget 1977/80, 249).

---

[46] In some cases simple abstraction is used instead of empirical abstraction but both refer to the same phenomena. For instance Inhelder & Sinclair & Bovet 1974.

When the object has been modified and enriched with the properties extracted from the coordinations, the abstraction referred to the properties is pseudo-empirical, for instance, ordering the elements of a group. In other words, pseudo-empirical abstraction is the abstraction of the properties of an object but one previously introduced by the subject. It is a particular case of reflexive abstraction and not a case derived from empirical abstraction. Reflected abstraction is the result of a reflexive abstraction which has become conscious to the subject (Piaget 1978, 223).

3.2 Conditions underlying problem situations

Thus far, I have presented a general approach to the Piagetian equilibration theory, extracting a few elements of his theory to show a conceptual standpoint on problem solving, and therefore on knowledge constitution from within a psychogenetic perspective. The central point is to explain the constructive character of any specific knowledge, the interactive processes hindering the constitution of knowledge and the crucial role of conflicts, perturbations or obstacles brought about in the subject-situation interrelationships.

If we accept the connection between learning, the constitution of knowledge and problem solving as a natural form of appropriation of certain domains of reality, it becomes especially important to observe the types of problems the subjects must solve everyday in the workplace. In short, what are problem situations like and how do they occur in everyday settings? Rather than presenting a definition of what a problem situation is, I shall try to analyze some elements that I understand should be focused on to address problem situations, in order to interpret the empirical evidence presented.

As stated before there have been many attempts to classify problem situations but it is difficult to find studies focused on the intrinsic characteristics of a problem situation or on the constituents of a problem. This aspect is one of the major issues I am concerned with. In following chapters I analyze the constituents of task-oriented problem situations by using empirical cases. But it is important to point out in this part the general conditions which underlie problem situations.

In general, referring to task-oriented problem situations, it could be said that they are of significance to the solver, that a task is accepted but the person does not know how to carry it out and its solution involves surpassing a cognitive obstacle for achieving success.

> **Significance:** as to the meaning of the situation, problem situations are significant for certain subjects participating in particular social practices. The significance for a subject of solving a problem proposed by a researcher or by a school teacher is not the same as a situation to be solved at work. The interaction between the subject and the general situation where a conflict may come about is essential for two main reasons. First, the particular problem situation arises in a wider context which constrains the solving procedure. Second, the same problem situation in a different context might simply be denied or discarded using Piagetian terminology.
>
> **Task:** The solution task the solver decides to carry out implies the development of a structuring activity by actualizing a set of actions according to the structural levels of development. This transitional process of acceptance is determined by different factors: from the solver's point of view the disposition of action schemes (developmental factors) as well

as the struggle to face the situation (individual factors). The acceptance of the task is not mechanical and unconsciously taken. On the contrary it requires the subject to be an active participant and cognitive acceptance as opposed to cognitive discarding.

Cognitive obstacle: The external perturbing elements may or may not imply obstacles in a strict sense. In any case a perturbing element is an obstacle but not necessarily a cognitive obstacle. The subject may face and solve the situation from the action schemes or structural levels already possessed. In this case I would say that there is a pseudo-obstacle. Instead when a new scheme is needed to solve the situation there is an obstacle in the strict sense. In this case both developmental as well as individual factors are jointly operating in task solution. In other words, it is necessary to take into consideration the characteristics of the perturbation and its corresponding type of reaction.

Success: Success in relation to the solving procedure constitutes another central aspect by entailing the social context in which the situation comes about. The goal of the subject's actions does not necessarily match the goal assigned by the context. For instance, the goal of any task designed by a teacher or experimenter might differ from that assigned by the solver. Similarly the relation between the controller and the problem solver would apply at the workplace. The solver applies certain criteria of success in the solving procedure but at the same time the context applies its own criteria of success. When both coincide success can be achieved. On the contrary when they differ from each other, there could be solution but not success.

These conditions are at the base of any problem situation. They are interrelated aspects of the same issue, problem situations. Conditions do not define but come close to structuring a problem situation as a thing, as a phenomenon.

3.3 Different approaches

Problem situations may appear in different forms, with different levels of complexity and with different degrees of signification for the subject involved, perhaps depending on the context in which problems occur. Within the school context, problems are situations designed by somebody (a teacher, a specialist in didactics, etc.) for pedagogical interventions. At the workplace, problem situations are not designed. Instead, they emerge in the workplace dynamics.

I shall now present different perspectives related to problem solving. In this area, De Vega (1985, 493-514) following Greeno's typology (1980) of problem solving presents a first classification through four general categories: transformation problems; induction problems; arrangement problems; and social problems.

a) Transformation: there is an initial state, a goal and a group of operations through which the initial state is transformed into the goal.
b) Induction: situations in which, to find the solution, the subject has to discover structural analogies - not of contents - between elements belonging to unequal domains.
c) Arrangement: these are problems in which a series of elements is presented to the subject. Thus, s/he has to reorganize them to determine a criterion.
d) Social problems: these are problems which are not well structured, nor are their goals well defined. Their most

> common solution strategy is to identify and eliminate the causes.

The category of social problems added by De Vega actually refers to the distinction between well and ill-structured problems or real-world problems and laboratory problems (Kahney 1986, 20).

The main distinction between these two kind of problems is that in the case of well-structured problems the solver is provided with different kinds of information: information about the initial state; the goal state; the legal operators; and operators' restrictions. In the case of ill-structured problems the solver is provided only with information about the initial and goal state.

The distinction between ill and well-structured problems brings up another element for considering the analysis of problem situations, i.e. uncertainty or the absence of certainty. Differences are established among problem situations whether they involve uncertainty or not.

> Well-structured problems, for example an arithmetic problem, can be described completely and solved with certainty. Real-world problems, such as what career path to follow or how to reduce pollution, can rarely be treated as well-structured problems since all the parameters are seldom clear or available and since it is difficult to determine when and whether an adequate solution has been identified. Therefore, we call real-world problems ill-structured (Kitchener & King 1990, 164).

I interpret that uncertainty governs any kind of problem situation to the degree that uncertainty becomes a particular characteristic of a problem situation. In my point of view, the distinction presented between well and ill-structured problems fails to take into consideration the decisive role of the social context in fixing parameters in the task solution, therefore constraining the possible solution. I would contend that problems, similar to some of those I present in Chapter 7 are mathematical problems. However, I would say that both the strategies for solving them and the ways of presenting the necessary mathematical understanding to solve them would not be interpreted as correct in formal settings. The certainty argued by Kitchener & King governing the mathematical problems, serves to prove whether a certain solution is mathematically correct or incorrect but not to prove whether it is successful. That is, as soon as we place a solution procedure in a particular social setting, success is achieved precisely when the strategy used and the final product become recognized by the social setting as successful. Let me recall the examples presented in chapter 2 (Mariño 1987). The system of numeration and the algorithms for calculating developed by the group considered are mathematically-well structured, but they would be completely rejected within a formal setting, such as in any school in Colombia.

Thus, the lack of parameters for identifying success in the solution procedure is in my view brought out regardless of the very influence of the social context within which the solution must be anchored. I shall focus on task-oriented problem situations and try to demonstrate that success is achieved when all the constituents of a problem situation are articulated, i.e. the solver, the social context and objective elements of the situation.

There is evidence that the cognitive process involved in solving so called ill-structured problem does not differ from the processes applied in solving well-structured problems. This evidence has come from the analyses of problem solving in geometry (Greeno 1980, 21-2). Ill-structured problem solving depends on the same general kind of knowledge as well-structured problem solving.

I would still like to bring up the question of problem formulation from another analytical perspective. To analyze the consumer´s behaviour in relation to preferences and choices (Kreps 1990, 17-37), we may examine a problem related to decision-making by health authorities, faced with an epidemic that is threatening the population within their jurisdiction. In doing so, the situation is presented as follows:

> As a doctor in a position of authority in the national government, you´ve been informed that a new flu epidemic will hit your country next winter and that this epidemic will result in the deaths of 600 people. (Either death or complete recovery is the outcome in each case.) There are two possible vaccination programs that you can undertake, and doing one precludes doing the other. The first will save 400 people with certainty. The second will save no one with probability 1/3 and 600 with probability 2/3. Which do you prefer?
>
> Formulate an answer to this question, and then try:
>
> As a doctor in a position of authority in the national government, you´ve been informed that a new flu epidemic, one of two possible vaccination programs is to be chosen, and undertaking one program precludes attempting the other. In the first program, 200 people will die with certainty. In the second, there is a 2/3 chance that no one will die, and a 1/3 chance that 600 will die. Which do you prefer? (Kreps, 1990, 20).

Differences in responses among medical professionals favoured the first programme-solution in the first formulation and the second programme-solution in the second formulation. However, both questions lead to identical outcomes. Therefore, the cause for why such a difference in the responses is to be found in the way that the problem situation was formulated[47]. Even though the absence of absolute certainty presented by the probability calculation they require, what becomes clear is the fact of influencing or pushing towards the choice of a successful procedure through the formulation of the situation.

Another perspective, that of Charnay (1987) connected with the utilization of the problems in a teaching-learning process, analyses the use of problems in three different learning models.

a)In the model he calls "normative", the problem acts as a control over learning and the scheme would be as follows:

mechanisms

* lessons (acquisition)
* exercises (practising)
* problems (utilization of the knowledge by the student, control by the teacher)

In this model, knowledge is portioned out for learning and the teacher controls the complexity of it. After a problem has been presented to the student, s/he looks for the solution mechanisms, if s/he already has solved a similar problem.

b) In this other case, I shall present the model called "initiative", in which the problems are used as learning devices. Here the scheme is as follows:

---

[47] David Kreps terms the problem of formulation as the way to frame or phrase the situation.

motivation	* situation based on life experience
	* contribution of knowledge
mechanism	* practice, exercises
resignification	* problems

In this model, the learning process depends on occasional or spontaneous situations, though not strictly. However, natural situations may appear as too complex for the student to find the necessary tools for solving the problem.

c) Finally, the author considers the model called "appropriate" in which problems act as media in the learning process. The scheme is as follows:

action	* problem situation (the student searches for a solution procedure)
formulation	* formulation - confrontation of procedures
validation	* new situation with different obstacles: new procedures etc.
	* new tool
institutionalization	* practising
	* synthesis, conventional language
	* problems: evaluation by the teacher, resignification by the student

The problems are presented by the teacher and their solutions act as the source, locus and control of knowledge. That is, through the solving process knowledge is presented and validated.

In this analysis, the problems are considered from the focus of pedagogical intervention. Even though the analysis is made in different models of learning, I understand, from a general viewpoint, that the former is governed by a behaviourist assumption and the latter by a constructivist one.

From another perspective, centred more on the psychological activity of the subject, a general theory of problem solving denominated *Information Processing Theory* has developed (Simon 1978). The theory describes behaviour as the interaction between an *information processing system*, a problem solver and a *task environment*, the latter representing the task as described by an experimenter. When focusing on the task, the problem solver represents the situation in terms of a *problem space*, that is, how to consider the task environment. These three components - the information-processing system, the task environment and the problem space - establish the framework of behaviour for problem solving. This theory has been mainly used in artificial intelligence research and programming. Information-processing psychologists such as Simon argue that a supreme test of the theory of cognitive behaviour is to specify the theory in such detail that it can be implemented as a computer program which actually performs the behaviour the theory is trying to account for.

Other studies (Schliemann 1988, 72-73)[48] in which the differences in problem solving of workers who have experiences of formal learning and workers who do not have been analyzed. A problem connected to working practices was designed and presented to carpenters. It most certainly must be an everyday activity for carpenters to calculate the quantity of wood they need for building a certain quantity of furniture.

---

[48] This study was presented in greater detail in Chapter 2.

But what is not clear is whether the formulation of the problem by the researcher contains or keeps the main characteristics with which the situation appears daily to a carpenter. In this study naturalistic observations were taken into account in deciding what kinds of problem to present and how to present them. The observations revealed that problem solving often occurs when a customer brings a drawing or a photo of a piece of furniture to be made to the carpenter.

The problem presented in this study reflects the working situation, for example, the need to make a quote for the wooden frame of a bed. But what is not clear is how the situation may vary for the solver, in terms of the solving procedure, when the customer is the one who accepts or rejects the quote offered. In other words, contextual constraints are not clearly considered.

3.4 The role of conflicts

Rooted in a constructivist position, whatsoever its particular development, the resolution of conflicts plays a crucial role in knowledge constitution (Kolb 1993, 146; Tennant 1992, 119-20; Mezirow 1990, 6; Freire 1972; Perret Clermont & Michel Nicolet 1992). Accordingly, the design of problems to provoke new learning is widely used in different settings e.g. school, work organization.

Research on problem solving originally made the distinction between performance based on knowledge and performance in problem solving. This division granted a higher status or degree to performance involved in real problem solving than performance based on knowledge. The latter was generally reduced to the simple application of algorithms, or remembering how to do something. This distinction had an undesirable impact specially in adult basic education. The lower value given to performance based on knowledge had a negative result for illiterates attending basic education. The knowledge illiterates constructed in work-related situations in their everyday life was not seen as potential school curricula knowledge. Such a wrong interpretation got credit as a consequence of the failure to identify a suitable knowledge base for the performance and therefore to translate it into school curricula knowledge. However research on problem solving has come to narrow the sharp distinction between knowledge based performance and problem solving.

> One of the consequences of the recent fundamental research in problem solving has been a serious erosion of the distinction between knowledge-based performance and problem solving. One cause of this erosion has been our increasing ability to identify the knowledge that is used when someone solves a problem - that is, when someone really solves a problem. All problem solving is based on knowledge. A person may not have learned exactly what requires some knowledge, even if that knowledge may be in the form of general strategies for analyzing situations and attempting solutions (Greeno 1980, 10).

In the case of illiterate and adult basic education the problem in my view still exists in the possibilities of transfering the knowledge used in everyday situations to the school situation. The problem with transference is not on the part of students but on educational design and therefore on the part of teachers and educationists.

On this point the relationship between content and form comes about. Conflicts operate on both the content and the form of task-oriented problem situations. Conflicts as motors and results of changes take place in the content (knowledge-based performance) and in the form (problem solving performance) of task-oriented problem situations.

In Chapter 2 I called attention to the differences between learning in the strict sense and broad sense from a Piagetian point of view. Here again it is necessary to draw attention to this distinction. Training techniques (learning in the strict sense) are essentially aimed at the acquisition of the formal aspects of knowledge (reflective abstraction) but they are always related to the acquisition of specific concepts, whose content (empirical abstraction) varies according to the technique (Furth 1974, 7). Conflicts may appear in both kinds of aspects and therefore training techniques should capture both aspects.

In my view the way to sort out such dichotomy is to struggle with the constituents of task-oriented problem situations. When designing an experiment or any kind of technique to promote learning conflicts, either as result or agent of change, consideration should be given to the whole rather than isolating the content or the form.

Another aspect necessary to stress is that action itself is potential knowledge. Subjects in any context solve problem situations by acting according to means-ends. This activity is already knowledge whether the subject is able to conceptualize what was done or not. This is particularly important in the case of adult education where special emphasis is given to awareness and critical reflection in the processes of problem solving by means of degrading the non-reflexive processes. Often it is argued that for a building worker to know how to do something at work is just practical or instrumental knowledge contextually bounded. But to attain some kind of formal knowledge there must be critical reflection and conceptualization.

> The belief that problem solving occurs only when a person lacks critical knowledge about the problem has put us in a position like that of a man who is digging a hole and never gets it deep enough because, not matter how far he digs, he is still standing on the bottom. (Greeno 1980, 12)

When a worker has learned whatever knowledge is required for performing a task, the worker holds knowledge even if s/he cannot explain it. This aspect is crucial at the theoretical and practical level for research on problem solving. Knowledge in any of its forms as well as problem solving performance involves cognitive conflicts which are in my view the same as actions for Piaget: potential knowledge. It is in the continuum of conflicting interactions where knowledge is constituted. Conflicts and constitution of knowledge are aspects of a single process of development. Therefore psychologists and educationists should give more credit to everyday activities and the resulting knowledge and problem solving procedures by struggling to identify what kinds of knowledge and solving procedures are involved in task-oriented problem situations.

3.5 Summary

In this chapter I have addressed the main points of Piagetian equilibration explanations. Conflicts and interactions are analyzed by considering two related aspects, abstraction and cognizance. Different approaches to problem solving show the variety of perspectives and uses of problem solving even though when problem solving is being analyzed in different contexts most approaches use tacit conditions underlying problem situations. I have introduced the conditions underlying task-oriented problem situations from the theoretical point of view.

Will it be possible to recognize school problems in comparison with the problems that emerge at work? Do they have the same significance for the subject in any social context? In the case of adult education, these questions acquire special relevance because it is very possible that an illiterate persons's conception of learning might be more like that of learning experienced at work than that of learning at school.

What should be captured here by investigating work-related activities are the constituents of problem situations. Thereafter, and based on those constituents, it might be possible to formulate problem situations related to different contents. Therefore, I would especially stress those contents that will never appear in work related tasks. This does not mean that certain contents appearing at work should be disregarded. On the contrary, they must be used as starting points of a process that develops them when intervening pedagogically. But if we were able to give an account of the constituents of the situations, then we might work out, within formal settings, those contents the subjects have no possibility of approaching, except in formal contexts.

Finally, we must not only identify the situations that constitute problem situations in the work setting for the subjects. But we should also be able to formulate them without them losing their form. Thus, the main topic to be faced in this regard leads us to the question of problem formulation.

4 - METHODOLOGY

In this chapter I present a Piagetian methodological approach and describe how it functions in this study. After discussing the Piagetian clinical-critical approach pointing out its main characteristics, I will go through the stages (see point 4.4) of this study showing in detail the decisions taken in the process and the grounds for them.

This chapter defines the research problem and comes closer to the empirical evidence. Though I am presenting data mainly after having framed my position theoretically, in practice, both approaching the empirical data and building the theoretical framework have constituted a single process of inquiry.

4.1 Piagetian clinical-critical exploration

In Piagetian studies generally the use of clinical exploration is presented as a function of the results attained and rarely do we find a characterization of this research perspective except for the specific research task at hand. There is very little explicit literature dealing with the core of Piagetian methodological approach. I shall present some of the main features of the method in order to analyze the use I have made of it.

Piaget's struggle to develop his own approach is related to the general question he was concerned with: the development of an epistemology with an empirical basis. Piaget claimed that psychology must be taken seriously (from the epistemological point of view), which means developing psychological research instead of inventing solutions through private speculations (Piaget 1970/85, 115-150; Kitchener 1986, 140-143). In other words, Piaget was committed to developing empirical, scientific epistemology. The study of the growth of knowledge presupposes two complementary methods, (1.) conceptual analysis and (2.) historical or genetic analysis (Piaget 1970/85, 127). Empirical verification is a condition in Piaget´s view, but not the "reading off" of experience as empiricists viewed it. For Piaget, empirical verification always involves a theory or a system of interpretation that structures and makes sense out of experience. Scientific observations are theory-laden and, as new theories or interpretations arise, facts may require reinterpretation and re-evaluation (Kitchener 1986, 142).

Piaget had to go beyond the pure observations of child behaviour and also beyond the psychometric techniques commonly used at the beginning of this century. Therefore Piaget started with a number of studies using clinical interrogation for formulating as well as verifying hypotheses. The new data obtained by Piaget constituted at that moment a gold mine for psychology and this was possible because of the clinical method. This potential and originality place Piagetian method among the best in psychological research. Clinical method is a key instrument for studying the complex formation of cognition (Vygotsky 1982, 31-32). From the first studies conducted by Piaget the method has been applied with modifications enriching the research approach for studying cognition.[49]

---

[49] For a summarized but extended review of Piaget-oriented research see Modgil 1974.

> This method has undergone a number of changes in the course of the investigations carried out by Piaget and his collaborators. Initially, Piaget conceived of the interaction which occurs in the acquisition of knowledge in terms of interindividual relationships and viewed intellectual growth in terms of progressive descentration of the child´s point of view. In order to explore their reasoning, he talked with children and tried to follow the often intricate patterns of their thoughts, taking as a model the "clinical method" in which the psychiatrist tries to discover the roots of a patient´s beliefs and to explore the nature of his pathological imagination.(Inhelder & Sinclaire & Bovet 1974, 19)

This analogy with psychiatric interviews was present in Piagetian studies in the beginning (1929). Though it is true that Piagetian methodological approach kept on developing based on this general analogy with psychiatric dialogues, its particular features came about little by little. These modifications were related to the objectives of the research. When Piaget started observing his own children he made natural observations combined with observations in contrived situations, but soon he turned to a combination of clinical method with experimentation for studying the concepts of conservation. Therefore, it is necessary to understand the historical transformations regarding the unity of the method through its diversity. That is, we can find many different variations of this methodological approach, but all share the main characteristics which constitute the core of the method.

The core of the method consists of the elaboration of hypotheses and their verification through the clinical interview or dialogue. The discourse includes instant checking of hypotheses (Perret-Clemont 1980, 33). This means a constant interaction between questions and answers but with specific focus on the answers of the subjects. Materials to organize the task are often used, e.g from simple clay pallets to sophisticated coloured toys. However they are not a precondition in psychogenetic studies. In order to be able to constantly formulate hypotheses during the interview along with the movement question-answer-new-question the interviewer needs acute theoretical awareness. Otherwise there would be a failure to take advantage of the novelties given by the subjects.

> It is certainly true that this method yields reliable data only if the experimenter has acquired a very thorough theoretical background and mastery of the interviewing technique. It is essential that he be fully aware of the various hypotheses which can be formulated about the child's reasoning and of the different techniques that can be used to test these hypotheses. He must know how to observe and listen to the child and how to react to responses, which will frequently surprise him. In fact, the more unexpected the child's responses, the more productive we consider the experiment to have been.(Inhelder & Sinclair & Bovet 1974, 21)

The theoretical awareness[50] on the part of the interviewer, which may seem trivial, is related with essential aspects of the clinical exploration. If we reduce the critical exploration to a simple instrument of data collection the theoretical awareness needed to formulate and check hypotheses during the ongoing interview would have no place. In fact, if it were so, it would be just a technique for collecting empirical data where two clearly identifiable moments come about: (1.) data collecting (2.) hypotheses (Castorina & Lenzi & Fernandez 1984, 114). On the contrary, the clinical-critical exploration constitutes a [illegible]hod characterized by a single process which comprises both aspects, data collecting and hypotheses, as complementary and interdependent.

---

[50] In my view theoretical awareness refers to the presence of the central theses of the theory when interviewing, i.e. interactionism, constructivism and equilibration. This is the only way for the instant checking which is a crucial aspect of the method.

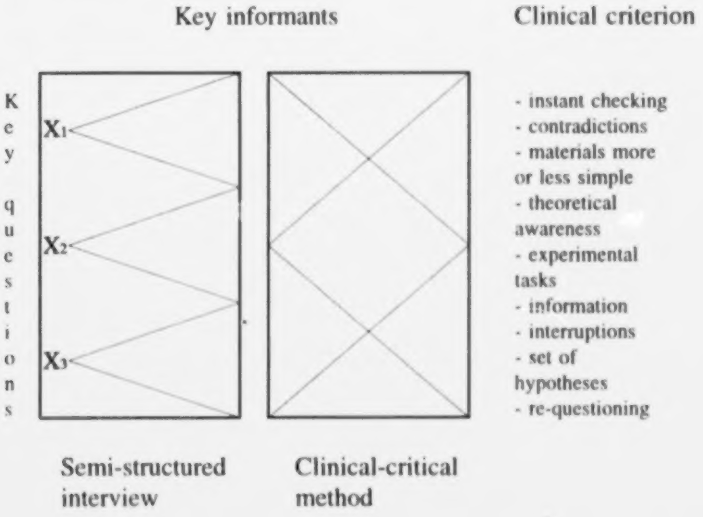
> The analysis and interpretation of responses relies partly on what is called *vérification sur le vif*. This fundamental feature of the critical exploration method requires that the experimenter constantly formulate hypotheses about the children's reactions from the cognitive point of view, and then devise ways of immediately checking these suppositions in the experimental situation. (Inhelder & Sinclair & Bovet 1974, 22)

In this paragraph the authors refer to experimental situations. It must be noticed that a clinical interview does not necessarily involve an experimental task. It is possible to conduct the interview using the subjects' answers and ideas as sources for checking and formulating hypotheses without presenting any experimental task. The point in any case is to focus on the arguments and justifications given by the subject and not solely on the "correct" or "incorrect" answers. Clinical interviews have been combined with different research instruments.

In France, studies on the role of different types of social interactions in development (Perret-Clermont 1980, 1-36) have used a dual clinical and experimental approach. The clinical method was used to get access to fundamental cognitive organizations and the quantitative experimental method to make comparisons. With a different research interest, Schliemann (1988, 69-85) has combined naturalistic observations with clinical interviews. The research focused on the differences in strategies of problem-solving between adults with formal schooling and adults without. In this study the interviewer presented a problem situation to the subjects during the interview. In Brazil, approaching the notion of space in adults without schooling (Colinvaux & Dibar Ure 1989, 172-200) have used the clinical interviews, which were conducted in groups. This way of using the Piagetian interview differs from the traditional studies as in these interviews were always conducted individually.

Up to now I have tried to focus on the main features of Piagetian method and to point out different uses of it. I will continue sketching the way I have used and developed the clinical-critical exploration for the purposes of the present inquiry. Figure 3. shows the two research procedures I have considered as methodological sources of inquiry by summarizing their distinctive features. Figure 4. shows the combination I have made of them to construct my own research instrument.

Figure 3. Two research procedures


Key informants
Clinical criterion
Key questions
X1
X2
X3
- instant checking
- contradictions
- materials more or less simple
- theoretical awareness
- experimental tasks
- information
- interruptions
- set of hypotheses
- re-questioning
Semi-structured interview
Clinical-critical method

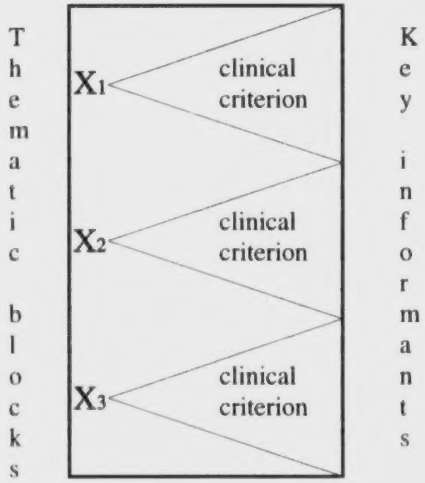
I will start by juxtaposing two alternatives, a semi-structured interview and the clinical-critical method (Figure 3). These two procedures are strictly speaking not comparable. The semi-structured interview is mainly a technique for collecting data in qualitative research. Instead, the clinical-critical approach is a full-blown research method as I have presented before. Figure 3 shows that the semi-structured interview allows the interviewer to go to a greater or lesser extent beyond the key questions (X_n in Figure 3). S/he may open each key question when s/he considers it timely or otherwise proper. However the interview has always a predefined structure, the key questions, which will eventually be asked of every subject of the sample. In principle a semi-structured interview does not allow the interviewer to alter the key questions or topics predefined. The researcher's freedom follows the structure of the interview and thus is adjusted to it.

When applying clinical interviews the dialogue develops differently. There is no pre-established order for the questions. The direction of the interview is led by the emerging dialectic between interviewer-interviewee, questions-answers and formulation of hypotheses-verification of hypotheses. With clinical interviews the researcher tries to extract arguments and justifications from the subjects in order to unpack the closed answers given by the subjects. This is done in the ongoing interview. The interviewee´s answers are the source of information for the researcher by which s/he guides the interview.

In this study I have combined both procedures, semi-structured interview and clinical interview. I have not applied them separately but in a single interview or research instrument. Instead of questions for structuring the interview I defined key topics or thematic blocks and for each one a set of possible questions. When I applied this interview scheme I went through the predefined thematic blocks but unpacked them by questioning according to the *clinical criterion*.

The term *clinical criterion*[51] refers to the general characteristics of Piagetian method and to the instrumental techniques for interviewing which are the core of the method. The term is useful to differentiate the classical clinical interviews put forward by Piaget from other ways of using the method. Figure 4 shows the combination I have used to construct my own research instrument.

Figure 4. Research instrument: semi-structured interview with clinical criterion


Thematic blocks
X_1
clinical criterion
X_2
clinical criterion
X_3
clinical criterion
Key informants

---

[51] I use clinical criterion in the same way that the term ***sentido clínico*** or ***espíritu Piagetiano*** is used in Spanish. The clinical interrogation is not to register questions and answers. The interviewer lets the subjects speak and tries to get the fleeing thoughts by following them.

The combination shown by Figure 4 matches to the third stage of the research process. It constitutes the application of the latest form of the research instrument to the final sample. The research process will be discussed in detail in 4.4. The key blocks were evolving alongside the exploratory interviews. The first interviews were conducted giving priority to the clinical criterion. There was no predefined structure for interviewing. The successive interviews gained some structure based on the information obtained from both the interviewees and the key informants. I shall present in 4.3 how the key blocks emerged.

In the final stage the interview had a structure to follow. The structure was given by the thematic blocks rather than key questions. But the structure was not based on a set of hypotheses independent of the data. Instead, the structure of the interview was all the time empirically anchored due to the exploratory process developed. The dialectic process between concept-driven research and the light thrown by the data resulted in a structure every time. This way of defining the structure of the interview differs from the usual design and application of a semi-structured interview. In addition, the clinical criterion used to explore the thematic blocks produces qualitative information according to the research focus.

4.2 Piagetian methodology in Adult Education

As I have presented in previous chapters, Piaget's works were confined to developmental explanations of childhood and consequently the clinical-critical exploration developed and was criticized within the same frame. I have gone through a research process keeping in mind the essential characteristics of the method and developing it according to the research objective.

In relation to the particular research problem of this study, Piagetian method helped to incorporate the information given by the subjects from the beginning and to use it to gradually define the object of study. This is an important feature which made it possible to enrich my own previous hypotheses by interviewing the subjects and formulating new hypotheses.

The original idea-driven research[52] was radically changed. Initially I had planned to design and present problem situations to the subjects to explore the knowledge involved in their task-solution. As soon as I started with exploratory interviews I realized that the design of problem situations was itself a central problem. I thought that problem situations could have been useful tools for approaching knowledge construction in out-of-school settings. But, what was a tool in the beginning became later the research focus. Two main reasons supported this decision.

> a) With the exploratory interviews I was looking for work-related content to design the problem situations. I was interested in those practices within each target group which could give better possibilities to analyze the knowledge the subjects use. But the question was, how to structure the work-related content to present a problem to the subject. Should I have designed a problem as teachers do in school? Certainly, I was able to identify much interesting work-related content but unable to design a problem with that content unless I used traditional school problems. The form or organization of content was the striking point.

---

[52] Idea-driven research is an umbrella term to refer to any and all of the thoughts that drive research. This is one of the categories used in the typology of the ideas that guide qualitative inquiry presented in *Posturing Qualitative Inquiry* (Wolcott 1992, 1-51)

> b) In other studies focused on problem solving in everyday life (Schliemann 1988, 69-85)[53] I could identify the same difficulty stated above. Problem situations are designed and afterwards presented to the subjects in their natural contexts, i.e. the work place. For the formulation of the problem situations the researcher has observed the carpenters´ everyday activities. Then, based on the information obtained in such observations, the researcher designs a problem trying to simulate the subject´s everyday problems. The main difficulty arises in organizing the information to simulate a problem situation. After observing work-related activities of the carpenters one can easily decide that the calculation of a price for making a bed is a context-related activity. However, to design or formulate the problem the researcher applies school criteria. The problem situation certainly looks like a school problem. The point here is the relation between the content and form[54] of the situation.

I have tried to tackle this obstacle focusing the study on the form or structure of the problem situation at work. In this regard, clinical-critical exploration offered me a good way to approach the research problem. From the theoretical point of view, I was concerned with the way the subjects themselves structure and organize their data to solve a problem in everyday practices.

---

[53] A description of this study is presented in Chapter 3.

[54] When I refer to the form of a problem-situation I mean the way that the content and information are organized to create a conflict for the solver, that is to formulate a problem situation. I do not see possible to make a sharp distinction between form and content. They refer to different but interrelated issues. The form refers to the organization or relations between the elements intervening in the situation, while the content refers directly to the topic or specific knowledge involved in the situation.

As this study is in the field of adult education, I find it necessary to make some points about the use of Piagetian approach in adult education research. For psychologists the methodological discussion focuses on the accuracy of critical exploration for studying cognitive activity. We may find radical critics of Piagetian method mainly from different epistemological paradigms, like empiricism, and also from within constructivism. But, undoubtedly 70 years of research work developing this perspective offers a good base to admit that clinical exploration can be at least a way to explore cognitive activity.

The problem may appear when Piagetian method is discussed within the field of adult education. Those who maintain that adult education should develop its own methodologies and interpretative theories may find it difficult to use Piagetian theory and methodology in adult education. I think this view is based on misunderstanding. Piagetian theory and methodology are not restricted to childhood but aim to develop understanding of the processes of knowledge in both the epistemological and psychological dimensions. Adulthood is a developmental reality less explored using Piagetian theory, but this does not limit the possibilities of the method. On the contrary, the situation calls for research development in this area. Although the critical exploration has been mainly used in studies related to children´s development there still are some studies which use this approach with adults (Nunes & Schliemann & Carraher 1993, 87-90; Colinvaux & Dibar Ure 1989, 173-200; Ferreiro 1987; Mariño, 1983).

> There are two persistent problems which are a feature of adult developmental psychology. The first is that there are insurmountable methodological difficulties in establishing phases or stages of adult life. The second is that much of the literature is historically and socially rooted and lacks any worthwhile generalizability. (Tennant 1993, 122)

The study I develop does not fit within adult developmental psychology as Tennant refers to it. I am studying subjects' developmental aspects although I am not referring to stages of development in adult life. I have made clear in previous chapters how problem solving and constitution of knowledge are related to developmental aspects, but I will not relate my data to any scheme of developmental stages.

The other point made by Tennant, the lack of generalizability of the studies, brings a crucial element into the analysis. The historical and context-based characteristics of a certain phenomenon does not necessarily bind the results to that particular context. In this work the focus is on embedded objects (or contextualized objects) as problem situations which are studied in work-related activities. However much the activities are studied in a context-related way, they are still in essence cognitive activities. As such, cognitive activities cannot be confined to the context where they emerge. Contextual influences must be addressed for studying cognitive processes as well as adult development, but neither bounding development to context nor ignoring the context. The results produced by any study must be considered in close relation to the theoretical system of interpretation they were achieved with and to the new interpretations or reinterpretations the results introduce in such theory.

4.3 Sample

The sample with which I have worked consists of adults from the suburban and rural areas of the city of General Roca, Province of Río Negro, Argentina. The ages of the subjects ranged from 20 to 60 years. The school experience of the target group varied from zero to four years of schooling.

Due to the fact that within the framework of the general project I was also making observations in schools for adults, I initially approached those who attended the course and expressed my interest in interviewing them in their homes. What I intended was to avoid the school context by conducting the interviews in their homes. Thus, it permitted me to make contact with other subjects within their family groups. They were adults, either without schooling or with little school education. I selected those who were not attending school at that moment. On arriving at their homes, there was generally somebody else desiring to participate in the interview.

In the beginning I interviewed two subjects at the same time. In turn, these subjects put me in contact with other subjects who were informed of the need to carry out individual interviews. As my concern was to visit their workplace, I had to refer to the employers for permission. The subjects interviewed did not receive any payment for the interview. However, the interviews were conducted during their working hours and no deduction in salary was effected by the employers. To conduct the interviews I visited the workplace with an assistant who registered the contextual situation manually and, when necessary, the drawings and gestures of the subjects used to explain questions presented to them.

In the first exploratory stage 12 subjects were interviewed, 6 women and 6 men (see Appendix 1, tables 1a, 1b, 1c). After the first stage, during which subjects were not chosen by their occupation, I had a rigorous task to select the subjects to be interviewed. The approach I had chosen required subjects with specific labour practices. But, as in the first stage, I had to carry out the interviews in the workplace, first contacting the employers, requesting permission to enter the workplace and to interrupt the work of the subjects. This was not easy, but I was finally able to contact the subjects and to ask them to cooperate with the interview. In this regard, I had a very good response from the subjects. In this stage of the process, 21 interviews were conducted (see Appendix 1, tables 2a,2b,2c).

Both the subjects of the exploratory sample and those of the final one come from the rural areas of Río Negro and Neuquén Provinces (north of Argentinean Patagonia). They migrated towards more populated suburban and rural localities, as is the case with General Roca. The main economic activity of this region is fruit production and its related industry. For the purpose of the data analysis, I took into consideration all persons interviewed, constituting 33 subjects. This was possible because of the homogeneity of the sample during the different stages (see Appendix 1, tables 3a, 3b, 3c).

Finally I have conducted six interviews for checking and supporting the analysis developed with the previous sample. For these interviews I concentrated on building workers. The interviews were conducted in the same area in Argentina. The ages as well as the school experience of the subjects follow the characteristics of the sample described for the previous stages.

4.4 Description of the research process

I have referred in previous chapters to how this study evolved. Here I will describe the methodological process. Due to the characteristics of this study, I started with an exploratory approach to construct the object of study. To this end the clinical interview, that led me to obtain a great diversity of answers, permitted the incorporation of the subjects into the research instrument to construct as well as enrich the hypotheses and the theoretical framework.

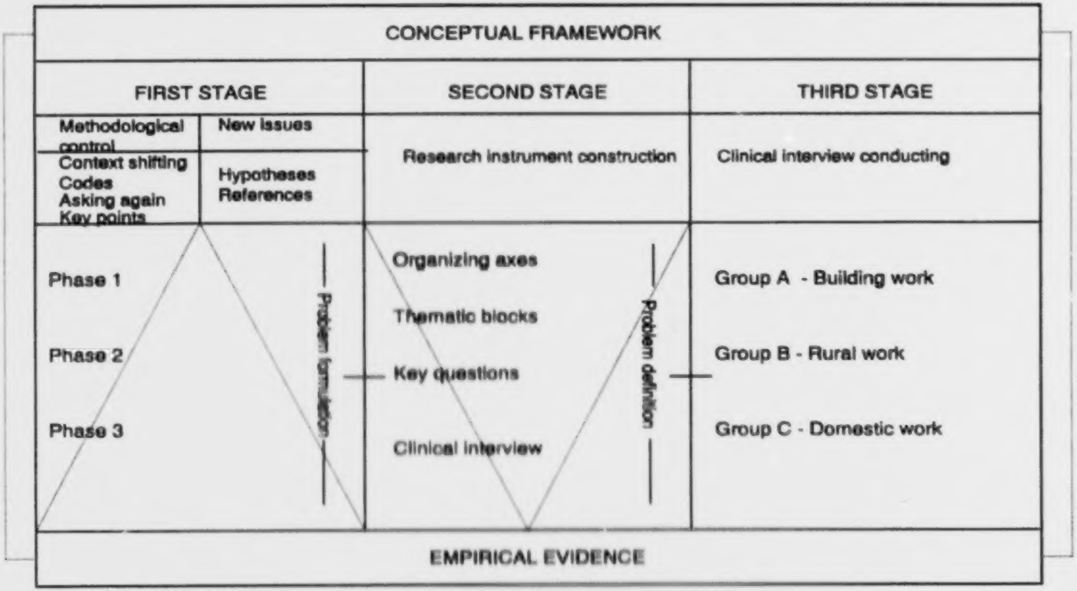
Initially I expected very few general ideas to define the study. However, the detailed analysis of every interview was crucial to plan the continuation of the research process. I shall try to show the dialectical process between theory and empirical evidence throughout the initial hypotheses, exploratory interviews, data analysis and the construction of the latest research instrument as well as its application. The process may be divided into three stages:

a) Stage I: formulating the problem. Different phases were defined within this stage by progressively enlarging the research lines.

b) Stage II: a standstill in data-collecting to analyze the data already obtained. At this stage, I was confronted with new possible hypotheses which constituted the widest realization of the research problem. Simultaneously, the approaches were classified on two organizing axes to describe the main aspects to be included in final clinical interviews. At this point in the process key informants were consulted about their labour practices.

c) Stage III: conducting the latest interview. Though the interview structure was followed, the clinical characteristic of the interview permitted the rephrasing of questions and asking more in depth questions when necessary.
In the following diagram I present the process developed.

Figure 5. Methodological design


CONCEPTUAL FRAMEWORK
FIRST STAGE
SECOND STAGE
THIRD STAGE
Methodological control
New issues
Context shifting
Codes
Asking again
Key points
Hypotheses
References
Research instrument construction
Clinical interview conducting
Phase 1
Phase 2
Phase 3
Problem formulation
Organizing axes
Thematic blocks
Key questions
Clinical interview
Problem definition
Group A - Building work
Group B - Rural work
Group C - Domestic work
EMPIRICAL EVIDENCE

4.4.1 Stage I

The previous questions or idea-driven research and the successive transformations generated by the data analysis throughout the different phases are presented below. It is necessary to point out that when data were collected, this study was a part of a wider project, *Adults in schooling situation: an approach to their reality*. The focus of the study was gradually changing and gaining definition.

Phase 1.

The questions during the first interviews were centered around three axes: a) the family b) work and c) the school institution. These axes worked like concept-driven research in the way Wolcott (1992) understands the term. That is, concepts lead the research in an orienting, consciousness-raising, but relatively independent manner.

a) The family: The central interest was in obtaining information about the opportunities the subject had to get formal schooling education. In doing so, aspects which had to do with the place of origin of the subject and her/his family, as well as the family structure and the level of schooling education, were considered. The reasons given for being in their present place of residence were taken into account .

b) Work: An approach to the subjects productive and working culture was of interest for obtaining information. I asked about the different work developed and focused on their characteristics, the type of labour relations, difficulties found in carrying out their work and the contexts where the work took place.

c) The school institution: The subjects were asked about their formal schooling. The questions were centered particularly on their motives for presently attending school or not, as well as on the reasons why they were helping their children to attend. They were also asked about their opinion or judgment about school.

Phase 2.

During the analyses of the three first interviews some new themes arose that permitted me to decide what the following interviews should focus on. They had to do with:

Learning
Knowledge
Objects of knowledge
Value of education
Specific labour practices

Learning: From this perspective, the meaning of learning for the subjects, related both to learning situations at work and at school, was explored. When cases appeared of subjects who had no school experience, the school experience of their children was asked about.

In this phase, questions were directly focused on the differences between work and school learning. The aim was to obtain an idea of the differences and similarities noted by the subjects in relation with ways of learning in different contexts, such as at school and at work.

Knowledge: In relation to knowledge, the subjects were asked about the differences they see between a person with systematic education and those who have non formal education. Generally, the questions referred to the workplace asking about the characteristics of the knowledge that the engineers who worked with them possess, in relation to their own knowledge (e.g. rural worker/engineer, building worker/engineer). When doing so they were asked to relate situations in which disagreements were encountered when the engineers carried out a certain task. What I was aiming at was to grasp their idea of "know-how" at work, as well as their ability to comprehend and explain it.

Objects of knowledge: In this aspect, the value or significance given to certain objects of knowledge was observed. They were asked what they would like to learn, as well as the motives and purpose for that learning. The idea was to observe in what contexts certain objects acquire value and the possibility to interact with them.

Value of education: The interest here was to gather evidence of the significance of general education for the subjects and their attitude towards it. In order to obtain data on the effects of schooling, they were asked about the differences they observed between persons who had attended school and those who had not.

Specific work practices: After having asked about the different work-related activities they had developed, the subjects were asked in more detail how they had done the tasks in order to detect the physical and logical mathematical notions used. The aim was to focus on problem situations they were confronted with.

The following paragraph presents one of the first interviews[55] together with its analytical commentary. This serves as an instance of the work carried out with the data supplied by the subjects. The information changed in successive interviews in accordance with the analyses produced and the innovations supplied by the subjects.

---

[55] Cornelio, 6.1.b.7. Through out the text cases will be refered with a name and a code. The first number of the code refers to the appendix where I characterize the interviews, the second number locates the stage, exploratory or final stage. The letter refers to the kind of work practice and the last number to the place it appears in the appendix.

Cornelio is a 43-year-old man who lived in the countryside until the age of 18 and later moved to General Roca. He had no school experience as a child and at present he attends a school for adults, works as a *peón*[56] on a farm and occasionally in the construction field.

---

[56] Untrained rural worker.

Interviewer	*Interviewee*
What work did you do in the country?	*Well, I took care of animals, I worked with shearing and that I did in the season, for example in December and January.*
Was the breeding for selling or for consumption?	*No, for consumption and when there was a surplus, it was usually sold.*
To whom did they sell it?	*To buyers who came from here, from the Valle.*[57] *They usually buy from us.*
Did they pay you in cash?	*A little in money and the rest in things they took away from here: vegetables...*
When you came to the Valle, what did you work with?	*In building...but for periods. Do you want to know where the basement begins from below?*
Sure, why don't you tell us?	*Well, according to the area you make a pit of about 60 cm in the ground. Cement, iron... at first you make, a level base from below, so that it turns out straight.*
How do you make a level base?	*Well...it depends on how it is, if it's sloping...or if there's well in the middle. It must be equal, because the wall recedes afterwards.*

In Cornelio's narration about the work he has carried out, certain important issues appeared, that had not been considered previously within the problem to be investigated. In relation to money, it would

---

[57] Abbreviation for *Alto Valle del Río Negro* = Higher Valley of the river Río Negro.

BEST COPY AVAILABLE

be interesting to ask him again about the mode of operating, how did he know that he was being paid correctly? When he was bartering and exchanging goats for vegetables, what procedures did he use for establishing the relation of equivalency between the products? Or perhaps no relation of equivalency took place as no transitivity was verified. These questions capture the notions operating in each one of these practices.

Another question arises: how are the prices fixed? By their use-value, by necessity, by the scarcity of the product or are the prices fixed by the buyers of the valley? In this case it should be seen whether the established relation between the magnitudes of different products is proportional or if it is approximate.

When Cornelio comments on how the basement is constructed, physical notions such as verticality, horizontality and resistance appear to be involved, as well as the metric decimal system and the notions of proportionality and volume. Now, how conscious is Cornelio about using these notions? What resources does he use for their application? These questions that continued to sprout from the different analyses of the data obtained along with the reading of the theoretical material created new perspectives for analysis.

Whilst advancing in the exploratory interviews, aspects related to the subjects' views about objects of knowledge and their modes of appropriation were appearing transparent. The same can be said of the recurrence of work practices to be considered when designing the problem situations[58].

---

[58] At this stage of the process I still had in mind the design of problem-situations to be presented to the subjects as explained in point 6.2.

Phase 3.

In this phase of the process the aspects considered are:

a) General approaches to assess subjects' representations on learning in different contexts.

- Differences the subjects establish between everyday knowledge and school knowledge
- The instrumental value of learning involved with learning at work and school learning
- The relation between learning and forgetting; relearning
- The way of living: little schooling or no schooling
- The idea of how one learns in relation to work and at school
- Differences in the significance attributed by the subjects to reading and writing and calculations
- Appraising the subjects' assessment of school
- Appraising the subjects' assessment of literacy
- Criticism of the school as an institution
- Criticism of the mode of teaching

b) Situations related to work practices. In the course of the analysis diverse areas appeared to be considered in the designing of problem situations:

Salary - knitting - purchasing and selling operations - barter - packing of fruit and vegetable preserves - construction - production of fruit trees - timber - social care procedures

4.4.2 Stage II

In this stage I shall show the construction of the latest instrument. After completing the exploratory interviews, I paused in the process. I analyzed the obtained data, but considered it as a whole, i.e. establishing relations between the individual data, observing the recurrences and innovations. As a result, all the possible ways to explore were found, extracting through each of them the different aspects or perspectives from which data might be analyzed according to the research problem. These aspects led to a synthesis of the hypotheses or representations of the subjects and the conceptualizations I could obtain from the theory. Some particular cases were considered. That is, data that only appeared in a few interviews, yet were qualitatively important, were not excluded.

Organizing Axes

(1.) Generalities characterizing the cognitive aspects of the subjects. Here I considered reading, writing and mathematical calculations as objects of knowledge for the subjects, considering the significance given by them as well as by the social context. Furthermore, the opinions of the subjects on learning were considered regarding both work and school.

(2.) The different working practices that determine the everyday life of the subjects. Especially the work through which the subject could appropriate certain physical and logical-mathematical knowledge was taken into account.

The decision to work from these organizing axes was preceded by a discussion that led me to narrow the focus of the study and to modify the original work plan. I considered the difficulty of designing the problem situations without relying on prior knowledge of better empirical evidence about the use of notions (physical or logical-mathematical) involved in work practices.

On the other hand, before designing the problem situations, it seemed important to investigate what a problem situation at work is for the subjects. I considered this specially with relation to the form or structure of a problem situation. The form was the aspect which was missing and not the content-related aspects of a problem. This new issue, even if it had to be included in the latest interview, will be worked into an exploratory mode, in order to investigate it more deeply in further studies.

(1.) Generalities characterizing the cognitive aspects of the subjects.

The following key points or aspects of investigation were extracted from the exploratory interviews in the analysis up to the closing of the first phase, in order to be considered in the interviews.

- The significance attributed by the subjects to reading and writing
- The significance attributed by the social context to reading and writing
- Reading and writing as the object of knowledge and its relation with the school
- Reading as an object that enables the appropriation of the written culture
- Difference in the value attributed to reading, writing and calculations
- Difference in the value attributed to reading and writing

- Relation between mental calculations and written representation of calculations
- Relation between reading and writing
- Relation between mental calculations and reading
- Relation between written representation of calculations and writing
- The instrumental value of calculations, the physical and logical-mathematical notions
- Mathematical calculations as objects of knowledge and their relation with the school
- Age as an obstacle for learning
- Difference between "know how to make" and "formal knowledge"
- Difference between school learning and learning at work
- At work one learns by seeing, doing, practising
- At school one learns through studying
- Practical and theoretical knowledge are articulated
- Relation between school routine and labour routine
- School learning is forgotten if it is not practised
- Forgetfulness in relation to daily learning
- The appraisal the subjects make of the school as an institution
- The critique the subjects make of school
- The critique the subjects make of the mode of teaching
- The appraisal the subjects make of the role of the teacher
- The copy book as a testimony of school learning
- The product of work as a testimony of learning in work
- The step from one social-cultural context to another (countryside - city), implies relearning
- Relation between ideology and language; "Knowing how to speak", "knowing how to pronounce"

- The consciousness the subject has about the application of certain physical and logical-mathematical notions in a working context
- The strategies the subject uses at work for problem solving are set models or constructions of her/his own

(2.) Different work practices

The following is a presentation of the different alternatives that appeared as possible practices to be considered for investigating the presence of physical and logical-mathematical notions.

> Construction - work with timber - pruning of plants - weaving - vegetable cultivating - barter operations - purchasing and selling operations - social care procedures - preparing preserves - cooking - work in packing warehouses (discarders, packers) - wage calculation (by the job, fortnightly, monthly) - credit operations - fruit-tree curing - plantation irrigation - animal breeding

Thematic blocks

Once the first classification had been established, the different approaches were grouped into thematic blocks. Each block included the aspects related to a particular topic. The criteria for defining the thematic blocks was on the one hand, the delineation of the relation between the themes with the general project and, on the other hand, the quality and quantity of information available for approaching a particular theme. The aspects of investigation which were not adopted for this first report, may constitute possible contributions to the general project and others are left as researchable problems for further studies.

Regarding the different work-related practices that arose in the interviews, I decided to take into account some of them and not others because of their representativeness within the study group. I decided to focus mainly on practices connected with building work - rural work - domestic work. The following are the thematic blocks:

READING-WRITING

* The significance attributed by the subjects to reading and writing
* The social significance of reading and writing
I * Reading and writing as objects that enable appropriation of the written culture
* Difference in value attributed to reading and writing

MATHEMATICS

II * The instrumental value of mathematical calculations
* Mathematical calculations as objects of knowledge

DIFFERENCES BETWEEN I AND II

III * Difference in value attributed to reading and writing and mathematical calculations
* Difference between mental calculations and the representation of calculations

RELATIONS BETWEEN I AND II

* Relation between reading and writing
IV * Relation between mental calculations and reading
* Relation between written calculations and writing

DIFFERENCES BETWEEN SETTINGS

* Difference between learning at work and at school
V * One learns at work by seeing, doing, practising
* At school one studies
* Passing from one social-cultural context to another (countryside, urban) implies learning again; relearning

* School learning is forgotten if it is not practised
VI * Everyday learning, even when not practised, is not forgotten

* In school learning the copy book is the testimony of what one has learnt. The subject is the owner
VII * In work learning, the product of the work is the testimony of what one has learnt; the subject does not own it

WORK-RELATED TASKS

VIII * Work (construction - weaving - preserves - pruning)

(See Appendix 2: work practices)

TASK-ORIENTED PROBLEMS

IX * The view the subject has of what is a problem in the workplace

SCHOOL EDUCATION

* The appraisal of the school
X * The criticisms the subjects make of the school
* The criticisms of the mode of teaching
* The appraisal of the teacher

EMERGING APPROACHES

XI * Relation between work routines and school routines

XII * Relation between "ideology" and "language"; to know how to speak, to know how to pronounce well

XIII * How conscious the subject is of the application of certain physical and logical-mathematical notions in the workplace

XIV * The strategies the subject uses for solving problems in the work context. Are they their own or are they models?

XV * Difference between "practical knowledge" and "formal knowledge"

For each thematic block, specific questions were formulated (see Appendix 3) that could generate answers from the subjects that would enable me to elaborate the theme. I have used those questions from the exploratory interviews that generated qualitative answers and fitted with the spoken language of the subjects

Special treatment was given to the work practice of the subjects. For each one of the selected work practices different situations were explored. These situations emerged from the data obtained in the exploratory phase and from the information obtained through other informants involved in those work situations, as for example with a weaver, a construction foreman and a farmer. This rendered valuable information about some specific work situations and enabled me to hypothesize the subjects' possible answers, taking into account the intervening variables in each case. The key informants supplied information related to those problematic tasks they identified in work-related activities. An example of the procedure followed for each work-related context is presented below.

Building work

Could you tell me how an octagonal corner is built?

- *Making it like that, does it always work for you? Doesn't the wall come out wrong? How do you know that? Do you know any other way of making an octagonal corner? Please, tell me?*
- *I have been told that sometimes a quadrant is used. Do you know about that? Please, tell me? But if you have to build a wall with an octagonal corner, for example from here until there (big distance), does the quadrant serve equally? And how do you know that the wall doesn't get twisted?*
- *Could you help me with one doubt I have. The other day I was told about the formula 3, 4, 5 and to tell the truth, I don't understand very well what it is. Do you know it? Could you explain it to me? But, why 3, 4, 5 and not 3, 6, 8? And does that serve equally well for a small or for a big octagonal corner? How do you know that?*
- *Tell me, how did you learn this formula? How did you learn to use the quadrant? Do all masons know it? And before knowing that, how did you make an octagonal corner? What is the most used method?*

Rural work

How do you prune?

- Why do you prune? How do you know where you have to cut a branch? Are all the branches cut equally? Why? I understand that you have to take the wind into account. Do you know about that? Please, tell me. And where there is no wind, do you still have to prune? If you didn't prune, what would happen? When do you prune? Why? How did you learn to prune? Do all the peons prune the same way? Please, tell me. And why do you prune this way and not another way?

Domestic work

Do you make preserves? Why don't you tell us how you prepare them?

Do you always use that quantity of fruit and sugar? If you wanted to make less, how would you make it? What happens if you put the same quantity of sugar to that quantity of fruit? How long do you let it simmer? Why? What happens if you let it simmer less? For example, how many jars do you need for that quantity? Of what size? And if you had only 1/2 kg jars, how many would you need? How did you learn to make it in that way? Do you know other ways of preparing it? Please, tell me. And why do you prepare it in that way and not in another?

Problem situations

> ***What is a problen situation?***
>
> *When you were working, did you ever have any problems? How did you solve them? What kinds of problems do you think there are at school? Are the problems at school different from those at work? What differences do you find? And, what is a problem for you? How do you solve a problem? What things do you take into account in solving a problem?*

The latest interview (see Appendix 4) was conducted considering the thematic blocks as a structure. As I stated in point 4.1, the thematic blocks were explored using the clinical criterion. The order of the blocks changed according to the interviewee. The blocks I, III, IV, X and XII were not directly explored as they had a clearer link with the general project. Moreover, at this stage the research focus was already on problem solving and the use of everyday knowledge in work-related tasks.

4.4.3 Stage III

Once the clinical interview was constructed, it was tested on three subjects in order to observe how it functioned and to make the necessary modifications for the final application. In conducting the interview, I tried to use two interviewers[59], but it was not always possible. The objective was that one of them would be in charge of conducting the interview and its recording, and the other would register in writing the gestures, suggestions or situations that seemed significant. When work-related activities were investigated, the written register of the resources the subjects used to complement the oral answer was very important.

---

[59] I would like to emphasize the positive collaboration received from María Haydée Villar, María Inés Salgado and Graciela De Rosa in conducting the interviews.

Due to the clinical criterion of the interview, it was possible to ask a question again, to ask controlling questions, to go into more detail and depth when interesting data appeared. All the previously defined thematic blocks were explored in each interview. The duration of the interviews ranged from 30 to 40 minutes, depending mainly on the interruptions (see Appendix 4).

As mentioned earlier, three distinct fields were investigated in relation to the work practices: building work, rural work and domestic work. In the case of the subjects who do building work, I had thought to ask them about the mode of construction of an octagonal corner, the preparation of concrete and the preparation of a rough cast. I always asked about the three situations, but in relation to the construction of an octagonal corner, only the brick-layers answered because this work is not done by the labourers. In regard to domestic work, I had planned to ask about knitting and making preserves. Here some subjects were asked about the production of preserves and others about knitting. Rural workers were asked specifically about the pruning of fruit trees. In general, there were no inconveniences because the majority carried out this activity.

In all cases, the questions varied according to the characteristics of the subject, especially because of their experience in that specific practice, but always taking into account the intervening variables that had been analyzed beforehand. When they were asked about the question of problems, I tried to make it as broad as possible, looking for richer answers in order to capture the ideas. In general, they were asked about this topic just when they were talking about their work, trying to use the problem situations that the subjects stated.

4.5 The limitations and possibilities of the data

The critical exploration has been criticized (Castorina & Lenzi & Fernandez 1984, 84; Vygotsky 1971, 52-3) as a subjectivist method due to the extreme freedom given to the researcher or experimenter. These criticisms are mainly formulated from the empiricist point of view. In my view, this kind of criticism fails to recognize that freedom is limited by the central theses of the theory.[60] The researcher is necessarily committed to a system of conceptual interpretation.

In Genetic Psychology beyond and above the hypotheses checked through the clinical method, there is a theoretical preference for working with some methods and not others. This theoretical engagement presupposes that there are forms of knowledge or systems of actions which are not observable. It is not possible to get access to those unobservable mechanisms just by posing isolated questions. The answers - containing the subject hypotheses, changes and continuities - constitute a whole which must be understood as such. A single answer can only be understood in close relation to the whole.

In this study the use of clinical method is linked with both the theory or conceptual system of interpretation and the object of study. The constitution of knowledge and problem solving, which are the focus of this study, are interpreted through Piagetian epistemology and psychology. For collecting data I have followed the clinical criterion of the Piagetian method as it allowed me to get information from the subjects which I could not have reached by observing, experimenting or applying a deep interview. Matching theoretical concepts with empirical data during the interview is a difficult task to achieve. This probably is the most risky point of the clinical method which may lead to the gathering of rather anecdotal data without much profitable information. However I have selected the most suitable cases to develop the analysis.

---

[60] I have summarized in Chapter 2 the central theses of Piagetian theory: interactionism, constructivism and equilibration as explicative processes of these theses.

Another point that is often criticized is the number of subjects sampled and thus the generalizability of the results. In the case of this particular study the sample comprises the main requirements from an exploratory and qualitative perspective. In the analyses and categorization I concentrate on the procedural aspects of cognition and not on the construction of notions. Thus, the range of ages of the sample does not affect the analysis. This point is very much considered in research into adult development as special attention is given to stages of development rather than mechanisms underlying development. Besides, the subjects were carefully selected considering their school experience and work experience. This is a crucial feature of the sample when relating the data and analyses with educational practices.

The categories and interpretative models presented in this study were construed out of data. This means that they are not categories artificially created from the theory and matched with the data but theoretical constructions as syntheses of empirical interpretations and reinterpretations. The categories comprise a dialogue between the central theses of Piagetian theory and the voices of the data. The categories are developed using excerpts from the interviews to foster the theoretical analysis.

In doing so, I have followed Piagetian tradition for presenting the empirical data. In this regard Piagetian studies are written showing a few cases on which the analysis is developed. The excerpts from the protocols or dialogues are presented as they actually evolved as raw material for immediate analysis. However, the excerpts themselves constitute something other than raw material due to the clinical criteria used when producing them. The clinical-critical method produces empirical data which speak for themselves.

4.6 Summary

This chapter begins with a characterization of the Piagetian methodological approach. I have pointed out the most relevant features of the method: (1.) conceptual and genetic or historical analysis, (2.) the clinical criterion for interviewing. In addition I have discussed the possibilities for using the method in adult education justifying the use of it for developing a research instrument in accord with the research focus of this study.

I have presented the process both for obtaining empirical evidence and defining the object of study. The subsequent stages of formulating and defining the different research aspects permitted me to conduct an interview with the clinical criterion, incorporating the subjects´ information and perspectives. This was useful for finding the key questions and the necessary information about the subjects´ everyday work-related tasks. Thus, I obtained information directly provided by the subjects instead of information I could have obtained, for instance, through natural observations.

This dialectical process, between the original idea-driven research and the empirical evidence constituted the principal way to construct the latest research instrument. In other words, what I have tried to discuss are the reasons for the process when selecting the aspects to be incorporated in the latest interview. The data obtained from the latest interview were analyzed together with those obtained in the exploratory stage for the purpose of categorization.

In the following chapter I shall concentrate on the analysis of task-oriented problem situations. The category and subcategories I shall present constitute the syntheses between the data, the theory and my analytical perspectives. In order to exemplify the analysis, the most paradigmatic cases of the sample were looked for. They are analyzed from the above mentioned perspective in order to justify the definition of such a theoretical construction.

5 - TASK-ORIENTED PROBLEM SOLVING AT WORK

The focus is on the analysis of the main elements defining the problem situation, the relations between them and their characteristics. I am not concerned with the strategies and procedures involved in problem solving for explaining developmental aspects, but rather the general characteristics of problem situations at work.

However, when approaching issues related to problem formulation one cannot leave out the links with developmental aspects. The main link is the way institutionalized educational practices design and use problem-situations for promoting learning, more specifically problem-situations should be designed to facilitate individuals' cognitive development. I will not address here problem situation formulation but the analysis I develop explains and characterizes task-oriented problem situations at work giving a base for rethinking educational design.

Task-oriented problem-situations, seen as goal-oriented activities, will at a certain point, require action which contradicts subject's spontaneous strategies or action theories. I refer to action theories in the same way as the concept of *theorem en act* (Vergnaud 1981) refers to the properties of the relations known and used by a subject faced with a problem-situation. However this does not mean that s/he is able either to explain (make explicit) or justify the action. Furthermore, goal-oriented activities refer to a set of actions which involve sub-aims or goals constituting a structured whole (Hautamäki 1995, 28).

In characterizing a problem situation, I begin by emphasizing its interactive aspect to avoid any reductionism through focusing just on the problem solver and her/his solving strategies. In other words, I see that any struggle to understand the situation should be regarded in a dynamic way. The phenomenon should be viewed as a dialectical set of relations which cannot be assessed by analyzing either theoretically or empirically isolated elements, such as a psychological subject, social context or contents. I would instead stress the need to understand the structural aspects of a problem situation.

The analysis I develop is rooted in epistemological constructivism following mainly Piagetian interpretations as presented in Chapter 2 and 3. Problem solving situations are regarded as interactive processes linked with the fundamental aspects of knowledge constitution. In this regard knowledge and its constituent mechanisms are neither preformed in the genes nor in the environment, but are actively constructed by the developing individual (Piaget 1970/85, Saxe 1991). Still I would like to add that the role of social environment in this process is not just social nourishment to be assimilated, but calls for an accommodation from subjects. This accommodation is a central process in development and in knowledge constitution[61].

---

[61] Perret-Clermnont (1980, 25-26) analyzes the social interactions as a causal factor in mental growth. Doise & Mugny (1984, 155-57) analyze, based on Piagetian theory but developing it, the interactionism and constructivism on the social dimension. They conclude that it would be more accurate to speak about as socio-interactionism and socio-constructivism moving from bipolar psychology (ego-object) to tripolar psychology (ego-alter-object).

This particular interactive process takes place within specific social practices, in the case of this study, work practices. Among the multiplicity of interactions and social networks that determine a particular socio-cultural context, e.g. building workers and rural workers, some situations require a problem-solving process as they contradict routinized activity. The work routine may provide a basis for solving task-related problems easily. However, the routine is broken when an event cannot be faced without reorganizing the task. Thus, a situation arises in which the routine task needs to be restructured.

The significance given to this new situation should be re-viewed by both persons in the context and the subject her/himself. The event that breaks the work routine may be overvalued by the social context, i.e. peers, supervisors, employers, when the development of the work as a whole is being threatened or depends on the solution. Meanwhile, the worker, whether knowing it or not, would be in a different position to reorganize the task. Consequently, these situations become significant for determined subjects within specific social practices. We may very well think how significant a mathematical problem proposed by a researcher can be for a worker in contrast to one that breaks her/his actual work routine.

The task the subject accepts to perform is constituted for her/him by a structuring activity through which a sequence of actions unfold according to the cognitive scripts and schemes mastered by the subject. During this sequence the subject may face obstacles that s/he has to overcome to succeed. The subject may assess and solve the problem situation through the cognitive schemes s/he possesses, or may have to constitute new schemes for solving the problem. On the other hand, the success - that consists of solving the problem - is strongly determined by the subject´s recognition of success and by the recognition obtained from other people as well as from completion of the social practice in which the problem arises.

In this chapter I will present some ideas by analyzing an empirical case and building some models of interpretation which may help to develop understanding. In doing so, I focuse on the constituents of a task-oriented problem situation and their relation with the work routine.

5.1 Building a model from the empirical evidence

The analysis of empirical data has led me to new syntheses involving theoretical interpretations of the data. These syntheses aim at describing the interrelationship of the constituents of task-oriented problem situations.

> Events and elements are important, but the examination of them as such is not enough to describe a phenomenon; this gives reasons to develop models, which identify complex networks of concept relations as well as to study changes in concept relations (...) (Kontiainen 1991, 9).

Models in social research are representations of aspects of reality or more general ways for analyzing reality. Models provide a systematized way of analyzing phenomena. Therefore a model is often given as a diagrammatic representation of phenomena involving different elements: some concepts which denote and stress certain characteristics of the aspect analyzed, the organization of these concepts in a visual space for showing the relations between them (Münch 1987/90, 216).

Social scientists use models in different ways depending on whether they want to check the models validity or apply it for developing understanding in new fields. My concern in this study is to build a general model by relating in a dialectical way a theoretical thesis with the content of the data. The model strives to represent the conceptual elements necessary to characterize task-oriented problem situations at work. The reasons for integrating the elements in a graphic model and not representing them as isolated elements are: a) the interdependence they have in real life and, b) the need for a comprehensive holistic view of the phenomena.

> It is certainly important to distinguish between: (1) situations in which the performer has relatively specific knowledge that makes problem solving quite easy; and (2) other situations in which the performer must resort to more general knowledge and procedures to solve a problem (Greeno 1980, 12).

However the specificity of available knowledge is a matter of degree, not kind. It is seriously misleading to label performance in some situations as problem solving and in other situations in which the same kinds of cognitive processes occur as not involving problem solving. Greeno states that a continuum should be called a continuum, not a dichotomy. But this continuum requires characterization and modelling. In this study I concentrate on the constituent elements of different problem situations. I see these elements and their interrelations as a continuum which may help with designing and presenting problem situations in educational practices. They are not meant to be extrapolated as such to educational practices but to be considered as a basis.

5.2 Constituent elements of a problem situation

Certain general characteristics of the problem situation remain invariable throughout the different situations described by the subjects. These characteristics permit me to identify elements possessing stability which I interpret as the constituent elements of the situation. These elements are: the problem solver, the objective elements of the situation and the social context.

In the majority of the cases the subjects refer to a problem situation and its solution describing different aspects which I have found possible to analyze through these constituents. My aim is not to present these constituents as ready conceptual packages for understanding problem-solving situations. Instead, the aim is to present them as devices to be unpacked and integrated in an analysis of the complex weave of relations involved in the situations. Classifications of different types of problem solving (Greeno 1978; De Vega 1985; Kahney 1986) are based mainly on differences and though they can be seen as useful tools for programming or designing educational practices they do not go far into the essential aspects that characterize problem situations. These classifications concentrate on the variety of problem-solving skills. This perspective is not enough to grasp the structural aspects of problem situations which are necessary for educational design. The obvious gap on this point led me to adopt the present perspective.

In Figure 6 I present the constituents of a task-oriented problem situation. In this chapter I shall concentrate on the general aspects of the constituent elements of a problem situation and their interrelationship. In Chapter 6 I shall go into details of these constituent elements by analyzing different empirical cases.

a) **The problem solver**: The developing subject appears to be the party responsible for solving or facing the problem situation. S/he is an active subject who has not only a certain structural level of knowledge, but also uses varied procedures of action to solve problems: procedures

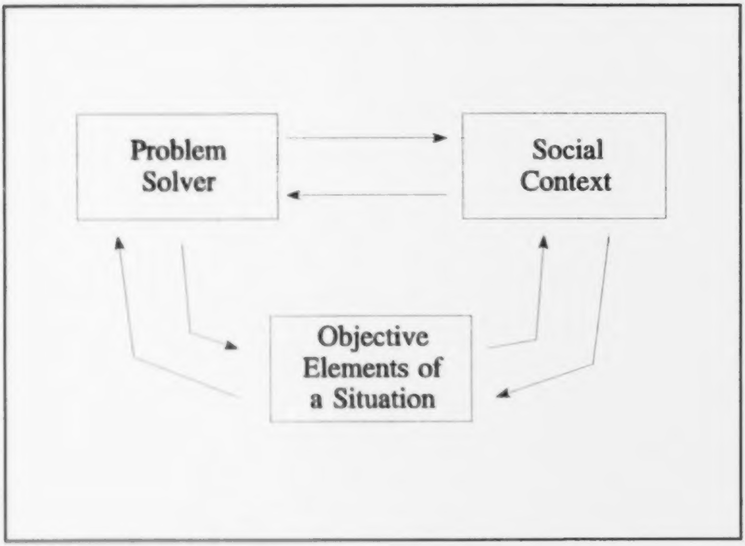


Figure 6. Constituents of a problem-situation

which are success-oriented. That is, they are aimed at narrowing the distance between the original state when the problem arises, and the goal state of the problem solved. The goal state can be understood as the success state (Karmiloff-Smith 1984).

b) **Objective elements of a situation (OES),** are the set of variables constituting the contents of the situation: the materials, instruments tools or techniques and the time and conditions that must be taken into consideration.

These elements the subject takes into consideration or uses in developing the solution. Sometimes the intervention of OES in a situation may generate a new task-to-be-solved within the main one. That is the case when the manipulation of the instruments needed for developing the main task is to be learned for a new purpose. At that point, the main task-to-be-solved is contingent on the secondary one.

c) The **social context** in which the situation takes place. The relations between employee and employer, experienced and non-experienced workers which by controlling work-related tasks directly influence cognitive performance. Events become significant for a subject or group of subjects because of both the subjects´ cognitive structures for integrating them and the meaning given to that particular event or situation by the social context.

I will present a case in which these elements appear to determine the solution process. It refers to a rural worker who had been asked to describe work-related problem situations. This is based on one of the interviews conducted at the workplace.

An example

Case 1: Bernardo (L.1.6.2.c.18)

Bernardo is 44 years old, went to school until the 4th grade as a child and lives in a suburb located in a zone of "chacras"[62] *together with his family. He has been working as a rural employee for more than 25 years. He showed enthusiasm during the interview.*

E: Tell me Bernardo, sometimes when you are working, do you have any problems?

I: That I would not know...?

E: For example...

---

[62] Chacra = small farm in Argentina in colloquial language.

I: Well, sometimes there are plants...there are branches: "I want to take that away" and then one doesn't dare. Because if you have a big branch and you take it away wrongly, you ruin the plant. Then that is a problem.

E: And how did you deal with that situation?

I: Well, I went and asked the engineer: "Look, to me this branch is in the way, (Bernardo relates what the engineer said to him) "Look, Anguita (Anguita is Bernardo's surname), if we can take it away, we shall do it or we can shorten it here and here" (Bernardo approaches a plant and marks two possible cuts and continues explaining to the interviewer). Because one works with the ladder all year round and this branch is in my way now, if I leave it, it will be in my way for another year. The ladder has a pole that has to be put between the branches, then if that branch is in the way, you have to cut it, because if you don't, you can't put the ladder there.

E: And if you could not have asked the engineer?

I: What happens is that there are companies that don't let you take away thick wood and others that do, because they like you to shape... that is called to shape the plant. For example, there are years when one has to shape the plants. You see, the branch bothers you and you cut it away. That is in case you are asked to shape the plant. On the farm, not only do you have to prune, one has to know the plant. (...) For example there are plants that you..., that are not pruned. You have to leave them or cut them with a handsaw, not with shears. That is the fine fruit, cherries, and someone who doesn't know what to do, goes and uses shears and dries the plant.
For example, we have parts here...to cut plants with an axe, cut it with your hand saw, yes. Work it a bit, but the shears no. The shears are poison for that plant.

The constituents in Bernardo´s case: pruning

a) The **problem solver:** Bernardo anticipates different possibilities in relation to the task. These anticipations are directly related to successful completion of the task. He wonders about the consequences of cutting a branch or not. Bernardo foresees the passing of time from one year to another and the growth of the plant. Yet he goes over the difficulties that not cutting a specific branch may generate for pruning the following years. Nevertheless, there seem to be particular requirements set by the employers that Bernardo takes into account to decide his strategy for the arming[63] of the tree.

In short, he shows an organization of the situation which seems constrained by objective elements and by contextual requirements. Thus, it means a procedurally successful set of actions bound by the constituent elements of the situation, the social context and OES.

b) The **objective elements of a situation.** There is a clear differentiation in relation to the type of plants. The whole task changes considerably if it is a fruit tree (apples, pears etc) or a fine fruit (cherries, apricots etc.) In both cases, different kinds of instruments are required. It is not possible to prune fine fruit trees with shears, says Bernardo. In other words, the use of the instruments themselves constrain the task and the success in the situation.

Furthermore, Bernardo refers to the pruning to be done in traditional fruit production[64]. He says quite directly that, if the fruit production had been by cordons, the problem he presented would simply not exist.

c) The **social context.** Some companies accept pruning thick branches while others give priority to the arming of the plant to facilitate the harvest of fruits, though the distinction whether or not to cut thick branches is a general way of defining different tasks. But, when it is clearly accepted by the worker and the supervisor, the distinction might determine the field of task. However it does not seem to be so in the example Bernardo presents. Nevertheless, he needs to ask about it. Consequently, the availability of the information needed to develop the task, in the right time and space, constrains the solution. In any case, this should be seen in connection with the sanction imposed on the worker when making a decision different from that of the supervisor.

---

[63] The arming of the plant means to take off those branches which later might interfere with the harvesting of fruits.

[64] Traditional fruit production means that the branches of the fruit trees grow freely. Production by cordons means that the branches of the fruit trees are interwoven through wires that serve as supports as they grow.

Shifting the focus now on to the worker, we see that the knowledge Bernardo had about pruning shows keen experience in this particular work practice. Bernardo is in a position to approach this particular task that differs from that of a novice.

Interrelationships of the constituents

Up to now, I have presented the three constituents I consider as characteristics of a task-oriented problem situation. I shall present now an interpretation of the relations between the constituents, that is, the relation between the structural aspects of the situation with its particular features and requirements when analyzed in interaction. Figure 7 presents the way I see the constituent elements come together in a task-oriented problem situation. I Identify different possible areas in the solution process that may help to interpret and to design problem situations. They are the success area and the broad field of the given possibilities.

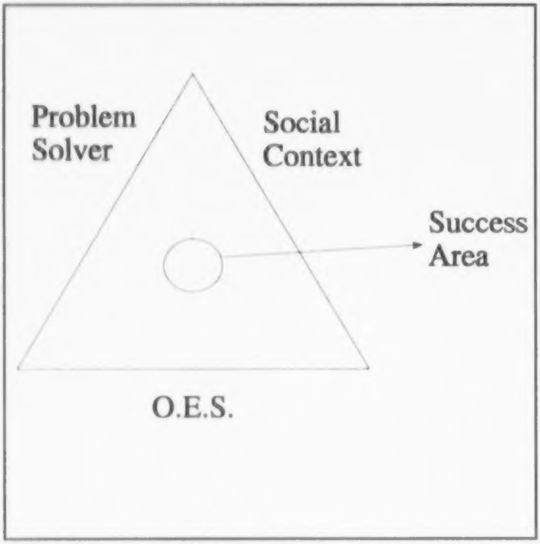


Figure 7. Interrelationships of the constituents

a) The success area

This area might be interpreted as the set of alternatives to successfully solve the problem situation. In this area, the successful solution is achieved when the organizing activity of the subject, the contextual requirements and the OES successfully lead to a solution. I am interpreting success as the state reached by a task developed, not only from the subject's point of view, but from his/her structural cognitive level, while considering the requirements of the context and the properties of the OES.

Success is achieved when the worker implements the solution strategy accurately according to the employer's expectations, e.g. to arm the plant instead of improving productivity, and regarding the characteristics of the OES[65].

We may hypothesize a solution, from the subject's point of view, in opposition to the contextual requirement. In this case I would say that there was no success in solving the task, though the task would have been correctly developed by the worker. There was a possible solution, but it was not accepted by the employer. But in analyzing the situation as a whole, if the solution runs counter to the social context, the conflict still persists and thus the problem is not solved.

The same would occur if we were to consider such a case in relation to the OES, that is, a case in which no success is achieved but a solution for the subject might exist disregarding the properties of OES, e.g pruning fine fruit trees with shears. In this case, we can observe, on the one hand, that damage is done to the tree because an incorrect instrument is used for pruning and, on the other hand, that it is expected that the work supervisor will not accept the task developed by the worker.

If we observe the effects in the social context: it is obvious that when no agreement can be reached, there is no success. For instance, although Bernardo correctly structured the procedural success, there is no availability of the necessary instruments - simply in time and space - for developing the task e.g. a handsaw or shears. And though the contextual requirements and the subject´s acceptance of the task as required by the context can be accomplished, there is no way to succeed.

---

[65] I present in detail the analysis of the OES in Chapter 6.

b) The broad field of given possibilities

The broad field of given possibilities refers to the three constituent elements in interaction covering the different alternatives for accomplishing the task. Within this area, a dynamic process of inclusion-exclusion starts. Different strategies may be imagined and attempted in particular situations. In graphic terms (Figure 6) there is a narrowing movement towards the success area. In a way, it is precisely in this area that we may certainly identify the problem situation. If we move out of this field, there is no necessary link between the elements. Then no problem may be characterized.

It is within this field that the task is anticipated and structured by the subject. Thus, to narrow the distance between the original state and the success state, it is not enough to consider only the subject´s cognitive competencies, nor the social significance given to the situation, but the three constituent elements in interaction must be taken into account.

5.3 Routines at work

The concept of routinization is often used to frame some psychological activities performed within everyday practices. However, the meaning of routinization is rarely cleared up and therefore it becomes a very fuzzy category though producing definitive conclusions. I try to make some points on this issue by considering routinized processes and problem solving at work.

This analysis is necessary because practical problem-solving is often viewed as a mehcanical set of actions governed only by efficiency and economy. Non-reflective strategies are used in routinized work-related activities. Learning in action in context is considered as non-reflective learning where either theoretical or practical validity is naively taken for granted (Mezirow 1990, 10). To see practical problem-solving in this way is seriously misleading. The premise for this interpretation seems to be that within the work routine conditions task-oriented activities are performed either free from contradictions and conflicts or strategies to cope with them are already known. The striking point on this interpretation is that one cannot refer to problem-solving as a form of knowledge production or human behaviour, if cognitive conflicts do not appear. This happens because the concept of work routine or the routinized processes are from the psychological point of view not addressed critically. Probably this reflects the uncritical extrapolation of concepts used in explaining social behavior to explain individuals' behaviour. Most studies refer to work routine as synonymous with non-problematic day-to-day activities. Routinization is seen as "vital" in psychological terms whereby a sense of trust or ontological security is sustained in the daily life activities of the social life (Giddens 1987/90, 387). What relates the sense of trust to the cognitive dimension is, in my view, the combination of the subject's learning experience and structural developmental level.

The problem solving process, as a particular interactive phenomenon, takes place and evolves within particular social practices, like work practices. A variety of interactions and social networks of significance determine a certain social context, e.g. building workers, rural workers, etc. Some of these interactions require a problem-solving process and others do not. The point therefore is to identify at least some of the two. As this study focuses on task-oriented problem situations I shall analyze those interactive situations which can be recognized as problem situations referring them to work routine. In doing so, I shall first characterize the work routine and then I shall relate the problem situation to routinized processes.

Routine refers to certain stability in the general conditions under which the subject develops work-related tasks. These general conditions are already known by the members of a work group. The general conditions refer not only to strategies but also to goals involved in tasks. Experience[66] plays a crucial role in the process of routinization of everyday activities. That is, the performance of a goal-oriented task requires successful procedures and experience that is already internalized.

Everyday activity is a broad concept that includes different kinds of processes, like routines, negotiations, conflicts, communication and so forth. I see routinized processes as one aspect emerging from everyday activities and characterized by the interrelationship between subjects' activity and content-related activity. Focusing on building workers' routines, for instance, we must think about sociohistorical constructs which by both general and particular rules give a basis for performing work-related activities.

> a) By general rules I mean those linked with the work-domain as basic instruments and techniques accepted for determining certain work practices, for instance by building workers. The use of the technique 3-4-5[67] or a triangle iron rule for constructing a square could be considered as a generalized technique and instrument among experienced building workers. I would also include under general rules the specific codes used by building workers which give the basis for their work-related communication.

---

[66] I refer to experience as a basis of learning in terms of individual-group interaction with events or situations.

[67] The use of this formula is analyzed in Chapters 6 and 7.

b) By particular rules I mean those linked with the achievement of specific sub-goals restricted in time and space[68] to a certain task. I refer to specific tasks which emerge in a work context, related to a certain content, demanding specific mastery from the worker to accomplish them. The foremen for instance, according to their confidence in their workers, either allow the use of the formula 3-4-5 by using a tape measure or require the use of the iron set square[69]. The decision of the foreman transforms a generalized technique into a particular rule.

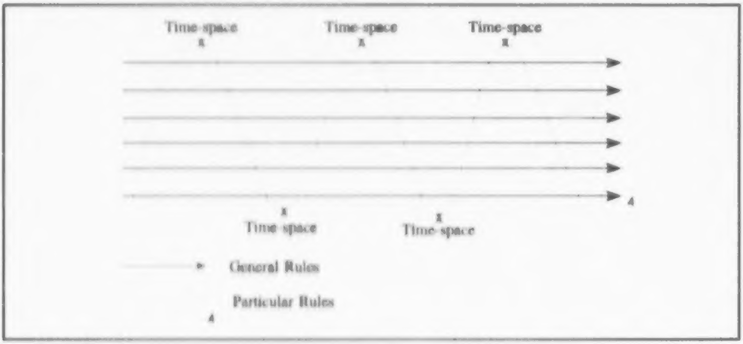

Time-space
Time-space
Time-space
Time-space
Time-space
General Rules
Particular Rules

Figure 8. Routinization process

Therefore, when the subjects can cope with different work-related activities by actualizing general and particular rules internalized through work-experience they are operating within the work routine[70]. Instead, when a subject cannot cope with the activity by actualizing experience the routine is broken and simultaneously the subject is faced with a new event. In other words a routinized task is problematized. This may occur because a technique which proved to work well for a long time does not work any longer for the same task.

---

[68] I refer to specific instances in time-space and content-related activities within everyday work routines.

[69] The use of an iron set square is common for novice workers as it leaves fewer possibilities for errors than the formula 3-4-5.

As I presented above, a building worker can use either the iron set square or the formula 3-4-5 to trace an angle of 90 degrees or to construct a square. For instance, a worker with little experience has used for a long time the iron triangle ruler to trace a square. The goal of such task would be to trace a square[71] and the instrument the ruler. This is a goal-oriented task which, with time became internalized and therefore routinized. In a given moment the worker is faced with the same task, tracing a square, but this time he has to put a wooden frame in a place where there is no room to use the ruler. The goal-oriented task remains similar but in this case the instrument does not work and therefore the situation must be reassessed. The original technique failed and a new event arose, a problem situation. The new event brings a non-routinized task to be performed. The acceptance of this new task by the subject defines a problem situation. I refer to the task acceptance as the subject's cognitive engagement[72] to solve the problem. The goal has not changed, it is still to trace the 90 degrees angle.

---

[70] I refer to internalization as the process that follows assimilation and accommodation. Internalization is either a new temporary or permanent state of re-equilibrium for a developing subject in Piagetian terms. Engeström sees internalization as the basis of learning and defines it as "the transformation of material, external actions into mental, internal actions" (Engeström 1994, 13).

[71] From the mathematical point of view the goal is to construct an angle of 90 degrees.

Finally I characterize work routine as domain-related processes sociohistorically construed which involve general and particular rules. The stability of routinized processes is the main feature. Stability does not mean immutability, but transformations of routine occur slowly. The difussion of innovations usually creates a transformation: new technology brings new routines. I see them as bottom up transformations, that is, particular rules may become general ones. In addition general rules together with the passing of time assimilate changes and reach new stability. Problem situations as events which break the work routine are vehicles for transforming the routine. Problem situations are vehicles in the sense that they make technological or other changes apparent to the worker.

I shall analyze the constituent elements of task-oriented problem situations in relation to work routine. However routinized processes are still in need of empirical psychological research within adult education. This issue has not been addressed yet and the data I have to work with cannot throw enough light on this aspect.

5.4 The constituents and the routine processes

I shall analyze at this point in Piagetian terms the reaction of the constituent elements of a problem situation when a conflict arises regarding the processes of reequilibration. This analysis helps to interpret the limits of the work routine and whether or not cognitive conflicts foster individual development.

---

[72] I see cognitive engagement as the significance and hierarchy the solver grants to the task; significance that is contextually and cognitively formed. "There could be some evidence showing that task-acceptance often leads to commitment, but it may also lead to task-rejection, if the task is too difficult, while uninteresting tasks probably lead to task-ignorance" (Hautamäki 1995, 3).

In Figure 9 I present the constituents in relation to the routine where a perturbing element does not break the routine. The perturbing elements which contradict the routinized activity may arise from any of the constraints applied by the constituents, that is, the problem solver, the social context and OES. When this happens the work-related task can be performed within the work routine.

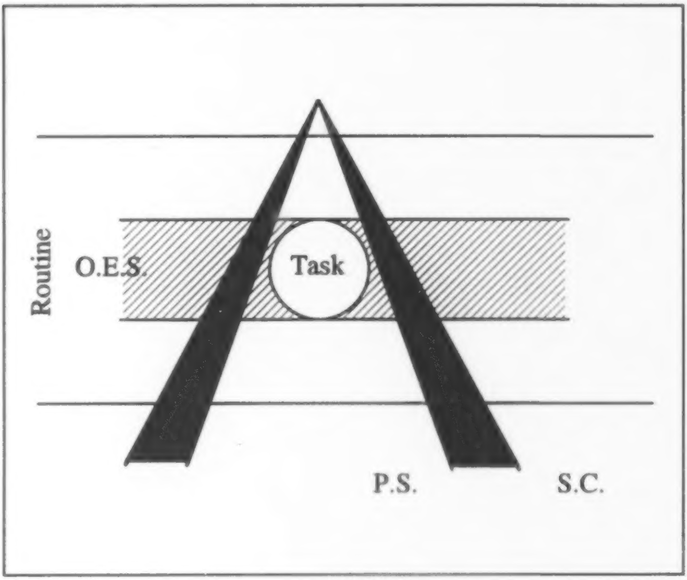


Figure 9. The routine as a base to develop the task

O.E.S.: Objective Elements of a Situation
P.S.: Problem Solver
S.C.: Social Context

The problem solver can in this case cope with the task just actualizing her/his experience in terms of cognitive structures. The task even in this case needs restructuring but it does not break the routine and the system remains the same. From the Piagetian point of view I would characterize this kind of situation by asserting that there is no real disequilibrium or at least if there is, the new state of equilibrium is imminent. This could correspond with reaction alpha[73] in Piagetian terms. Reaction alpha is defined as the reaction created when a new fact surfaces and according to the case, produces no modification of the system at all, or it produces a perturbation. The graphic shows that whatever perturbs the routinized task can be easily assimilated. This situation would be an intermediate between a non-problem situation and a problem situation.

Let us see what happens when a perturbing element really breaks the routine and produces disequilibrium.

---

[73] In Chapter 3 I have explained the main features of the equilibration of cognitive structures by presenting the different types of reactions.

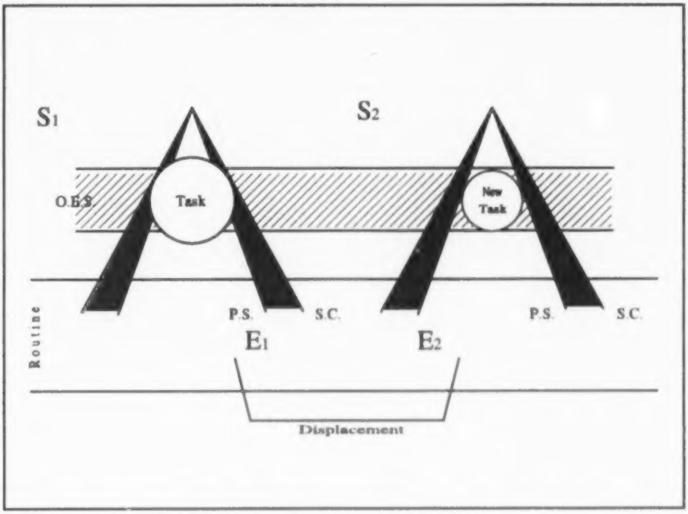


Figure 10. Break of the routine

S: Situation E: Equilibrium
O.E.S.: Objective Elements of a Situation
P.S.: Problem Solver
S.C.: Social Context

In Figure 10 the task goes beyond the limits of routine. In this case the routine does not give the necessary base to cope with the task as neither general nor particular rules are enough for developing the task. In S1 there is a conflict which brings the whole situation out of the routine. The conflict begins either because of the complexity of OES or because of particular contextual requirements. To cope with it the problem solver needs to reach a new state of reequilibrium by restructuring the task. In this case the system changes and there is a displacement of equilibrium. Therefore the unexpected fact which broke the routine becomes assimilable. This displacement means restructuring the task by transforming it to become assimilable. For that the problem solver either establishes new relations to incorporate the perturbing fact to her/his already organized structures or creates new structures. Figure 10 could be interpreted as reaction beta in Piagetian terms. This reaction to perturbation leads to integrating into the system the perturbing element that has sprung up externally.

Confronting the situations presented in Figures 9 and 10 it is possible to observe that in the first case the routine is enough to cope with the new event but in the latter a problem situation certainly arises . In my view the situation presented in Figure 9 is the relevant one to consider when designing problem situations aimed at promoting learning in educational practices.

5.5 Summary

In this chapter I have introduced the constituent elements I see as necessary to consider task-oriented problem situations. I presented them in relation to each other using an empirical case to illuminate the analysis (Figure 6 & 7) and identified two main areas for explaining the interrelationships, the broad field of given possibilites and the success area. I show that the narrowing process between the possible given strategies and the success state is constrained by the social context.

The analysis of the link between routines at work and the emerging of problem situations give the basis to understanding problem solving at work. I have focused on a psychological perspective in characterizing routines pointing out general and particular rules operating and constituting routines at work (Figure 8). General and particular rules together with time and space where they evolve determins the routinizing processes.

I have used Piagetian types of reactions alpha and beta to sketch the relation between the constituent elements of a problem situation and the routines. Figure 9 sketches a case in which a perturbing element can be assimilated by the problem solver within the work routine. Figure 10 shows a situation which requires reequilibration from the problem solver because the perturbing element actually breaks the routine.

In the following chapter I shall analyze in detail each of the constituents of a task-oriented problem situation by presenting different empirical cases. In doing so, I focus on the problem solver, the social context and the OES.

6 - CONSTITUENTS OF A PROBLEM SITUATION

In this chapter I shall characterize each of the constituent elements of a task-oriented problem situation: the problem solver, the objective elements of a situation and the social context. In the preceding chapter I have introduced the constituents and the need to consider them in order to analyze the problem situations. Furthermore I have sketched the possible interactions of the invariants and their relation to the work routine.

Piagetian explanations on the processes of knowledge have often been criticized because of the dualism between subject-object used for interpreting knowledge. I have gone through this discussion in Chapter 2 to avoid from either misinterpretation or reductionism of Piagetian terms. The analysis I present on problem solving through the constituents clearly precludes all dualistic interpretations. The three constituents are necessary although perhaps not always sufficient for the analysis of the problem solving processes. I term these elements constituents because they are essential concepts to characterize problem situations.

I will look at the constituents separately along with empirical cases aiming at opening up questions which may be useful to understand the complexity of the constituents.

6.1 The problem solver

I shall consider separately the intervening subject as one of the three constituents for analyzing problem solving situations. In doing so, I point out the epistemic features, as well as the psychological ones. However, I shall not go through these aspects, as they have been treated in earlier chapters when presenting the theoretical approach. Instead, I shall attempt to relate these aspects to the empirical evidence.

My intention is to characterize the position of the subject within the problem solving process, both theoretically and empirically. Thus, I am interested in a subject anchored in a specific out-of-school social practice. The purpose is not to analyze and to contrast the subjects' performances in everyday cognition (Rogoff & Lave 1984; Nunes & Schliemann & Carraher 1993; Schliemann 1988). Rather, I intend to view individual problem solving in out-of-school settings. That is, as problem solvers to be integrated into a general characterization of problem-solving situations.

As compared with the passive epistemic subject of empiricism we find an active, developing subject. Problem situations do not emerge from the work routine as packages that the worker may assimilate mechanically. An organizing activity is required and its essential characteristics cannot be reached by analyzing stimulus-response series. An external stimulus becomes significant for the subject because there is a cognitive scheme for actively assimilating it (Piaget 1970/85, 135). Moreover, this stimulus, as situations or objects for interacting, acquires particular significance within different social practices.

The subject develops a structuring activity of the reality and structures the situation s/he is facing. The subject goes through the situation establishing relations, anticipating actions and results, organizing the elements and taking into account the intervening elements and the success aimed for. That is, the subject's organizing activity is aimed at narrowing the distance between both the original state and the successful state. Any reading of a physical experimental fact presupposes an internal structuring activity of the data by the subject. More precisely, the experience is never accessible except through logico-mathematical tables, i.e. classifications, orderings, correspondences, functions (Piaget 1970/85, 89; Castorina 1984, 19). The subject does not carry out a direct reading of the new event s/he is facing. Instead, the reading is made from the assimilation schemes s/he possesses, while signifying the situation and showing the subject's organizing activity.

> What conceptualization supplies to action is a reinforcement of its powers of anticipation and the possibility, in a given situation, of devising a plan for immediate implementation. In other words, its contribution is to increase the power of co-ordination already immanent in action, and this without the subject's establishing the frontiers between his practice (What must I do to succeed?) and his conceptual system (Why do things happen this way?). (Piaget 1978, 215)

When the subjects I have investigated are confronted with a problem situation, they are the sole protagonists of the solution process. That is, they alone are facing the situation and have to act to solve the problem. This acting does not refer only to a pure external action, on the contrary, it refers first and foremost to an internalized activity, that is structuring and anticipating the situation. This describes a proper activity of an *active subject*.

In some cases, the subjects are confronted with a new situation which they are incapable of solving by themselves. These cases generally come about when the new situations are not closely related with their work routine, when the contextual requirements like the employee's expectations are not known or when the instruments required for the solving process are complex.

In such cases, another more experienced person may be available to consult with more information or better means to solve the problem. However, in all cases, the search for the required information to solve the problem is made by the subject him/herself. Thus, these cases provide even more evidence that subjects solve the problem situations actively.
I shall present some excerpts from the interviews to illuminate the position of a problem solver in relation to a problem.

> *Case 2: Clemente (6.2.b.8)*
>
> *Clemente is 37 years old, he works as a building worker and has no regular work. He attended school as a child until the 2nd grade. He comes from the countryside but lives at present in a suburb of General Roca.*
>
> *I: Tell me, do you sometimes find problems at work?*
>
> *S: Yes*
>
> *I: Please, tell me about them.*
>
> *S: I have found so many...like there was...for a...to start with a corner, one can at best...I have to make a wall on this side, and the other on this other side and I have to think it over, how to do it.*
>
> *I: How is that? How do you think it over?*

> *S: I start...I think perhaps of making it, both the wall that comes like this (Clemente points out in direction A)*[74]*, and the other one that goes like that (making reference to direction B); it's difficult. That's where I make a lot of mistakes. But by thinking it over, I might try a 3/4 or a 1/4 and that's it. And that's how one gets it going, to be able to start with that wall. (he points out the origin O). And...once you've got it going from that point, then the other one is easy for me since I got the first one started.*

In Clemente's narration, we can observe that his first answer is that he has to think the situation over in order to be able to solve it. Without further details it can be understood that Clemente requires at least a certain type of reflection to solve this problem. This explanation brings up a key element when considering problem-solving processes. A problem situation emerging in work-related tasks requires a pause to think it over. Consequently, it does not seem to accord with the argument that work-related problem solving would not be governed by the logical organization of the task (Rogoff & Lave 1984, 7) but instead is governed by practical and efficient activities.

When Clemente was asked how he thinks it over, he started to describe the strategy of solving the problem and to give evidence of how he organizes the steps to execute the task, identifies the central core to be solved. In other words, at first he has to succeed in the precision of one wall to be able to continue with the other one. Even when he was not asked to explain the options 1/4 and 3/4, it was evident that Clemente considered different alternatives.

The following is another case of a building worker in which the organizing activity of the subject is evidenced.

---

[74] Bernardo's references can be understood as an angle of 90 degrees where A and B are the constituent segments and O is the origin.

Case 3: Amado (6.2.b.11)

Amado is 67 years old and he is a construction worker. As a child he went to a rural school until the 3rd grade. He has been living in a suburb of General Roca for many years.

I: Tell me, in your work, have you ever found any problems?

S: Well, sometimes you find one. But you know how to solve it. You start looking for the way to attack it, the way that gives the best result.

I: How do you go about finding the way?

S: It's logical! Because you just start to understand. Let's suppose this: there is a square that is out of true (at an oblique angle), or a plumb, a door or a window was put in wrongly. Afterwards it was moved or it was drawn. Then you have to fix it ...

I: How about telling me about it?

S: Let's suppose a door...you put the plumb in another time...the plummet, then the drawing triangle and the ruler to correct it.
It's logical! If you don't know what to do, you ask the official...your fellow worker.

This example brings other elements into consideration. He presents two possibilities, i.e. solving the problem by himself or asking for information. It is interesting to note that his first alternative was to figure out the problem. In terms of the prior example, it would be to think it over. This might be interpreted as re-designing the task. Once more the example shows that the problem solving process does not seem to be a simple trial-error action, but rather an organizing activity by the subject. If a door is out of true, Amado anticipates the necessary instruments; the plummet, the drawing triangle and the ruler, and then establishes the order for using them.

On the other hand, the second alternative Amado proposes is the possibility of not being able to attack the problem and to revert to seeking information by operating within the social context he works in, e.g. by approaching the official or his fellow worker. In any case, Amado keeps on being the one who anticipates a possible solution or seeks information in order to solve the problem.

In this example, I have no evidence about the nature of the information that Amado was seeking. However, due to the explanation given for the first alternative, i.e. defining the problem, it is not easy to imagine that the information to be obtained would take the form of an explicit recipe to be followed. Instead, this might be key information for Amado to redesign the task.

Both in Clemente's and in Amado's cases, what is focused on is an organizing and anticipating activity for solving work-related problems. An active subject remains empirically evidenced which supports the epistemic subject defined by the Genetic Epistemology. Nevertheless, I find this important because it is deduced from what the subjects tell us. The conclusion is that the subject anchored in a particular social context such as the workplace should be considered in relation to the psychological theories as well as to the pedagogical practices, when designing problem-solving situations whether for intervening pedagogically or as tools for experimental studies.

6.2 The objective elements of a situation (OES)

In this subcategory I shall consider the OES separately. As presented earlier, I defined OES as those variables directly involved in the contents of the situation: the dimensions of the materials, instruments or tools and the time and conditions that must be taken into consideration.

In the problem situations presented by the subjects, notable differences remain evident. These come about from the point of view of the particular materials intervening in the situations and of the actions the subjects develop towards the materials during the solution. I have found a device for interpreting the OES in the distinction made by Piaget (1970/85, 90) between logical-mathematical and physical-chemical transformation. Piaget refers to these two transformations as for distinguishing different types of actions the subjects produce for approaching the objects.

It is not the same to unravel a sweater as it is to demolish a wall or to prune a plant, not only because of the obvious observable differences in each of these activities, but also because of the transformations they imply on intervening materials.

According to the type of transformation that the subject produces on the materials used, distinct situations will be defined in relation to the possibilities of whether or not of returning to the original starting point. I am not referring to the original state in the solution process, as presented earlier, that is, when the subject has accepted the task and the solution process starts. Rather, I am now referring to the possibilities of whether to return to the original state of the OES, which is not the same as the original state of the situation since the situation has changed due to the application though wrongly, of some strategy.
At this point, it seems to be important to analyze these differences, as they require different activities. Even though it is impossible now for me to establish to a limited extent the differences that define distinct problem situations, we can observe in the data different possibilities for the subject´s activity in the cases presented. To analyze the differences between problem situations, we should observe the behaviour of the

final product, whether the final product permits the recuperation of the materials constituting it or not.

In the first case the constituent materials of the final product did not require modifications, at least not substantial ones. Thus, they did not lose their particular conditions and behaviour. Consequently, we are confronted with a situation in which the subject can redesign the problem and face another task by modifying the unsatisfactory strategy used earlier.

In the second case, the materials constituting the final product required transformations that made them lose their original essential conditions. Even when some kind of recuperation of the materials might have been achieved, they could not be used to return to the original starting point of the situation. That is, we are confronted with transformations in which the subject does not have the possibility to reinstate the situation, at least not by using the same materials.

I will describe the case of a housewife which presents an example of knitting. This example may throw light on the analysis of different actions.

Case 4: María Antonia (6.2.a.5)

María Antonia is 33 years old, she works as a housewife and lives with her husband and two children in a small house situated on the "chacra", where her husband works. María Antonia has no school experience. Just three years earlier she moved from the rural area to the Alto Valle. Her children go to school.

I: Tell me, María Antonia, have you ever found any problems while working?

S: Yes, I have found many problems.

I: Let's see, why don't you tell me about them?

> *S: I found a problem that I couldn't cast on stitches, I didn't know how to carry them on the needles, then I started it. Do you see? And then I dropped some stitches and I couldn't pick them up and continue. I said: this can be solved, but, why can't I do it? Then I started to knit the stitches, I knitted it, but the tension was too tight, because I started...when I started to knit, I held the yarn too tightly, I didn't carry it loosely enough. I had to carry the yarn loosely on the needle, in order to get the knitting going, but...I kept on pulling the yarn tightly and the knitting was too tight.*
>
> *I: How did you solve it?*
>
> *S: I solved it, I unravelled it again and I started the knitting all over again. I unravelled it again, I knitted it again and then it turned out. I went on knitting it and my problems were solved. What problems I had with the knitting...!*

In the case of María Antonia we observe that in referring to a problem she directly reverts to a concrete situation with a particular content. In this context, knitting, she identifies the obstacle: not knowing how to cast on stitches. Then she describes the steps carried out in the solution process. Here the elements in play keep on appearing in this situation: the yarn, the needles and the tension she should have applied to the yarn. Furthermore, she also describes how to relate these elements to the final product, the knitted garment.

We see what characteristics María Antonia's actions have on the development of the task: to cast the yarn on the needles, to apply more or less tension, to compare the result of more or less tension, to knit and to unravel. These are actions that might be considered logical-mathematical ones.

The materials used in the task do not require physico-chemical transformations. That is, they do not lose their substantial characteristics. Perhaps they might have suffered some modification. It is possible that the yarn lost some body, but its original conditions were not lost. Thus they could be reused.

In this example we can clearly observe that the actions applied to the materials permit the subject to return to the starting point of the situation to modify the strategy used originally. Let us observe another case in which the solution process implies transformations in the intervening materials, with regard to the final product.

Case 5: Feliciano (6.2.b.14)

Feliciano is 36 years old and has no school experience. He works in a "chacra" developing all types of work and he also does building work.

I: How do you solve problems?

S: At work, what kind of problem? ...(silence) That a wall doesn´t work out.

I: For example...

S: Oh, a rough-cast that turns out badly... And it has to be demolished.

I: It has to be demolished?

S: Once it´s been finished, it can´t be done. Once the work´s been started, well, you say, look, I started it the wrong way, well, it´s got to be done over again. But once it's done, I don't know, you can´t demolish it all. If there is a solution for solving it...If it is possible to do it, you can do it and you don't... Let's take a base, the base for making a floor or a frame. Then you make the floor. You make the frame, the base, after that you make the floor. When you want to build the wall, you make a frame again and... Let's suppose that this side turns out to be 20 cm bigger than that one... Well, there is one solution, because if I build the wall that way, when I raise the house, it will be all wrong.

I: Do all the problems have a solution?

S: Of course, because...well, yes, say this is not right. Then...But a solution. I make the frame again...the base there is too wide in the width. Here it is 20 cm wider...Here it is less...And then you have to make the frame again, there is nothing you can do about it. To make the frame again...It's clear. Here you have to make the frame...A piece of the base protrudes because you have to adjust this, you have to make the frame with that, and that, and this is too long here...Instead of the wall coming here...because if you started here, you have to

> *start in this way. It goes straight and this piece of the base goes out... and here you catch it just in the right place and here it is too long and why? Because the frame was badly made. And there you have the solution. And there a piece is too long, but it doesn't matter...I say. Once the work has been started, you have to put in a lot of care...After when it has been done, I don't know. How should I know! But I don't think so...*

In Feliciano's case, we observe that in referring to what a problem is, he also thinks about a particular content, preparing rough-cast. Then he identifies the problem as an unsuccessful result of a process: a wall or a rough-cast badly made. Feliciano initiates his narration referring to a badly made rough-cast and states that to solve the problem, it must be demolished. But as he cannot sustain his original hypothesis, the demolishing, he abandons the theme of rough-cast and starts referring to another situation: making a square base to build up walls.

Why can he not sustain his original hypothesis of demolishing the rough-cast? A possible answer might be found in the characteristics of the actions involved in the situation, that is, because the preparing of a rough-cast implies physico-chemical processes that transform the elements making them lose their original characteristics, and thus not having the possibility to "demolish" and start again, it is not possible in these situations to return to the original starting point. The lime, the sand, the cement and the water cannot be reused for making a new mixture for rough-cast.

What we have here is a situation radically distinct from the previous example involving María Antonia. The modification of strategies is evidenced in the problem solving, according to the characteristics of the objective elements intervening in the situation. In the examples of knitting, the actions involved were mainly physical-chemical ones. Instead, in building work, the situations, e.g. rough-casts and octagonal corners, involve both physico-chemical and logico-mathematical actions.

6.3 The social context

The social practice in which the situation comes about is an important element for considering the general functioning of the constituents. Social practices themselves should be adressed to reach better understanding on the processes of knowledge constitution and problem solving. However, in this study I analyze social practices in terms of influences produced in problem solving processes.

Social practices are viewed as the set of social interrelationships established among the participants at work. These social interrelations refer to the relations between employee and employer, experienced and non-experienced workers and the like.

> By a practice, I refer to a socially-constructed activity organized around some common objects. A practice involves bounded knowledge domains and determinate technologies, including symbol systems. A practice is comprised of recurrent and interrelated goal-directed actions. Participants in a practice master its knowledge and technology and acquire the mental and manual skills needed to apply them to the accomplishment of actions' goals (Scribner 1983, 104).

This characterization incorporates the crucial elements for contexts or social practices. This is usually not clearly considered in the studies belonging to the Piagetian tradition. This may be due to the explanation given by the equilibration theory, in contrast to the explanation of developing cognitive structures through the acquisition of socially developed forms of signs, such as language and numeration systems.

However, what Piagetian theory (Piaget & Garcia 1982) offers to analyze the influence of the particular social practices in the subjects' developmental processes is the significance socially given to objects or situations, therefore attracting the subjects' attention to them. Thus, I shall consider the influence and contingency that the social dimension has upon the procedurally successful task when solving problems at work, that is, the net signification that goes above and beyond a particular situation affecting the problem-solving processes.[75]

Other Piagetians have pointed out that social factors do not merely provide social nourishment to be assimilated but call for accommodation from the subject. The accommodation itself creates novelties and is a causal process factor in mental growth (Perret-Clermont 1980, 25). Focusing on social factors I refer to social context as one of the invariants to consider in characterizing problem situations.

Studies on cognition and problem solving use the category of "context" in different ways. Basically two types of contexts are distinguished, the social context and the physical context (Jacobson 1992, 316). Other studies (Ceci & Roazzi 1994, 74-76) distinguish a third context, the mental context as the manner in which an individual represents the problem at hand.

The meaning I give to social context in this study does not match exactly with other interpretations as it includes also the physical setting where the problem situation emerges. I find it difficult to agree with such separation from the Piagetian point of view. The equilibration processes, as explicative mechanisms of the constructivist and interactionist thesis, constitute a single or unified process. This process includes aspects belonging to the social as well as to the physical context. Otherwise it cannot be considered without serious methodological problems. However, I use social context instead of just context because in my view the distinction is relatively meaningless. Socially developed contexts are always interwined with physical settings, that is, socially-constructed activities evolve around common objects delimiting a particular social practice.

---

[75] For a review of social-cultural influences from within the Piagetian framework, see Saxe 1991; Piaget & García 1982, "*Ciencia, Psicogénesis e Ideología*" in *Psicogénesis e Historia de las Ciencias*. Siglo XXI. Buenos Aires.

The social context considered as a constituent for characterizing problem situations acts by signifying not only the situation itself, but also and primarily the solving procedure and the final product. What is meant by a final product is the material result of the task, e.g. an octagonal corner. The controlling role of the social context is the central issue.

A worker confronted with a situation may develop a problem solving strategy to succeed, but it may not be approved by the person who controls the work. There might be a better, more economical or more secure solution, both according to how the controller presents the situation and the position of the controller as opposed to the problem solver.

A domestic worker in charge of preparing apple jam, for example, may solve the problem and prepare the jam obtaining a colour or acidity that the employer dislikes. The final product may be rejected even if the ingredients used, e.g. the sugar, fruits, water, and procedures, were correct. Instead, the analysis would change if the colour and acidity desired by the employer were clearly specified before initiating the task. The question is whether or not the information was available at the outset.

From another perspective, the problem solver will doubtlessly interpret the situation differently, depending on whether it is her/his first working day or whether s/he has been working in that job for some time and enjoys the employer's confidence. Depending on the experience, s/he faces or defines the task for her/himself in different ways. We could imagine the same subject solving a problem situation for her/his own personal interest, e.g. building his/her own house or preparing preserves for her/his family. In such an instance, a certain problem situation is confronted by the way in which both the context and the subject within this context, signify the very contents of the problem situation.

To find a solution for building up an *ochava*[76] is for a group of building workers not the same as finding the correct proportions of materials for preparing concrete. The preparing of a concrete blend is an activity carried out by workers of a category lower than that of a foreman. The construction of the "ochavas" is a task assigned to the foremen, at least within my target group. However, it is difficult to imagine that both problem situations would be very different to solve regarding the complexity or the required structural levels of knowledge. The following example is of a building worker to illuminate the influence of the social context on the development of a task.

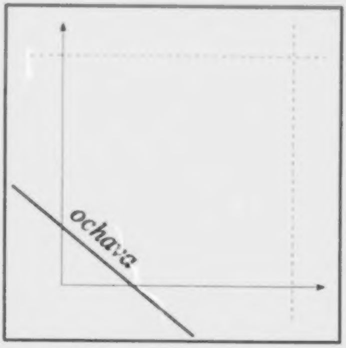


Figure 11. *Ochava*

---

[76] *Ochava* means the octagonal corner of a house.

Case 6: Fabio (6.2.b.9)

Fabio is 20 years old, he works for a construction company as a bricklayer's assistant. As a child he attended school until the 4th grade. The interview was interrupted several times by the person in charge of the work.

I: Do you have problems at work?

S: No, I don't. Until now I have not solved any problems here, as I told you, I am only an assistant...preparing the mixture, throwing bricks, putting up planks, helping to bring down lime and cement...Until now I have had no problems.

I: Fabio, and if you have to make an "ochava"?

S: I won't make it, why should I make it since I am only paid to be an assistant. Because the official and the half-official are different, the assistant is different...

I: Imagine that you would have to make it!

S: No, I won't make it...Well yes..., I have never tried it, but if I had to make it, say, for my own house, if I were to build my own house tomorrow, I would make it.

I: How would you make it?

S: Well, first you make the frame...at first you have to put..., to erect a wall of 15, or of 30, eh...you make the square, that is the first thing to do, of course, after the basis has been made. If you don't have to prepare the concrete, to reinforce the iron..., the wall can be erected...

I: And if they tell you that if you make an "ochava", you will be promoted to an official's assistant?

S: Ah..., in that case I'll do it. (He laughs)

In Fabio's example we can observe how the construction of an *ochava* takes on different meanings. At first, based on the status that Fabio has at work, the construction of an *ochava* does not directly appear as a possible problem situation. He does not seem to be ready to consider it a problem to be solved at work until he attains a different position.

BEST COPY AVAILABLE

Throwing bricks, putting up planks and so on, are routinized activities for Fabio within this particular social context. Consequently there is no problem situation.

Nunes & Schliemann & Carraher (1993, 28-47) analyze in Street Mathematics and School Mathematics, the effect of the problem conditions on the choice of procedures. They conclude "...that physical settings (street-school) and the particular type of relationship (customer-vendor or teacher-pupil) are not crucial factors leading to the choice of a procedure" (Nunes & Schliemann & Carraher 1993, 35). It is argued that there are culturally-accepted practices that take place in particular settings, but that are not conditioned by them. However, despite these conclusions, in the case of Fabio we observe a certain kind of tension between the subject´s and context´s demands which may affect the solution procedures. At least the success-procedure varies, that is, the strategies that lead to success.

It is difficult to anticipate how the strategies might vary in the case of Fabio working only as an assistant, having to build up an *ochava* but for his own use. But what seems to emerge is a different predisposition for assuming the task and consequently for solving the problem. In other words, constructing an *ochava* could very well be a problem to be solved in the construction of Fabio´s own house.

This is an important point which is often disregarded. The relation subject-task (or solver-situation) changes according to the social context where it takes place. Let's examine different alternatives.

a) Fabio as an assistant within the building work context: The problem does not appear as result of the status held by Fabio within this context.

b) Fabio as a foreman within the building work context: The problem situation might appear as he would accept the task.
c) Fabio on his own within a family context: The problem situation certainly might appear and he would be ready to do it.

Piaget & García (1982, 245) have made clear that situations become the focus of attention for individuals as a result of the influence of the social environment and social paradigm. I understand that both expressions refer to the same concept but with different analytic dimensions, psychological and epistemological. For the purpose of this study I favour the use of the term social context because it fits better and makes clearer the main idea.

I would also point out that in building for himself, the approval of the final product, i.e. an *ochava*, acquires different characteristics. That is, in such a case Fabio would simultaneously act as the solver and the controller. Probably, the family members would somehow act as co-controllers but in a different way than experts or work mates within a work context. To continue analyzing the influence of the social context, let us look at another case of a rural worker.

Case 7: Solorza (6.2.c.17)

Solorza is 60 years old. As a child he attended school until the 2nd grade. He works as a rural worker in an experimental "chacra" of the Instituto Nacional de Tecnología Agropecuaria. Initially he showed little disposition to participate in the interview, but acceded in the end.

I: And while pruning, have you had any problems?

S: Only, if I cut a branch wrongly, a branch that the boss didn't want to be cut, then he came and said to me, "no, man, that one should not be cut".

> *I: And how do you know whether you have to cut a branch or not?*
>
> *S: Well, it's what the boss says, whatever pruning he wants. We cut away the ends of the branches, as I told you...others "pistonean", they leave the branches very short... Because I used to prune when the English were here. The English were straightforward. We pruned a branch and it didn't please them, the Englishman came the next day...the boss...He checked all the rows. "And why did you cut this branch?", I was asked; and we had to explain to him why we had cut it... You had to be careful, because he would be angry with you; Eh? I never cut a branch without asking first.*
>
> *I: And if you didn't have anyone to ask?*
>
> *S: And if I didn't have anyone to ask, I would just leave it like it was, yes...and the next day, I'd go and ask anyone, the boss, the foreman..., no... I wouldn't cut it.*

In Solorza's example what is evidenced is the force of the context in determining a decision, as whether to cut a branch or not. On the one hand, he states that the type of pruning to be done depends on both and, thus, also the way to cut the branches. But, at the same time, the example also shows us how, in a situation in which the employers have a strict code, he always leaves the branch as it is and asks for instructions. It might be possible to imagine that in a context that is not so rigorous, perhaps Solorza, when having to decide whether or not to cut a branch, might in some cases choose to cut it without it being a bad job, but rather a different solution strategy.

What I have tried to show here is that problem situations, at least task-oriented situations, may not be considered without focusing on the social setting in which they occur. The social context plays a key role in validating the success of a solution task.

6.4 Summary

The constituent elements are essential concepts to characterize task-oriented problem situations. I have presented them separately by analyzing excerpts from different work-related activities. Two cases for each of the constituents are analyzed.

The position of the solver is analyzed in specific task-oriented problem situations. The analysis shows the proper activity of an active subject both psychologically and epistemologically. The solver is the sole protagonist in the solution process. Particular cases show that in case the solver cannot cope with the new situation the search for the required information is assumed by the solver him/herself.

The OES are those variables related to the content of the situations. OES are analyzed considering the distinction made by Piaget between logical-mathematical and physical-chemical transformations. These transformations define different kinds of situations according to the possibilities the solvers have to return to the original starting point of the solution.

The social context as a constituent of the situation directly influences the solution procedure. Contextual constraints evolve in the solution from the signifying and controlling role of the social context.

7 - THE USE OF KNOWLEDGE AT WORK

In this chapter I include the analysis of some situations in the workplace. I am concerned with use of knowledge. I will show the subjects´ knowledge as revealed when interviewed about particular work-related tasks. This part of the argument is important in three aspects.

a) First is the empirical verification of a theoretical postulate, that is, the empirical identification of an epistemic and psychologically active subject.

b) Second is the implication of this empirical evidence with regard to adult illiterates. This identifies adult illiterates as potential participants in educational practices and is directly linked with how to deal with them when intervening pedagogically.

c) A third aspect is that the study was conducted in out-of-school social settings, such as the workplace, not traditionally seen as settings that facilitate the construction of knowledge. At least, the knowledge that is acquired is usually not seen as something that could later be developed in other social settings, such as in school.

The interaction of the subjects with determined situations or objects implies a structuring activity by the subject upon the reality. As a result of this interactive process, the subject and objects are transformed. Thus, the origin of the knowledge is not to be looked for either in the objects or in the subject, but rather in the interactions between the subject and the objects. The relation between subject and object is to be understood as the relation between subject/group and object/event.

From some positions, a status that transforms knowledge into simple practical knowledge or knowledge in action is granted to the knowledge used in task-oriented working situations. As empirical knowledge, cognitive processes are governed by technical rules (Mezirow 1981, 3-4). Though from this position it is accepted that instrumental actions always include some organizing activity on the part of the subject, the activity is limited in this learning domain to predictions about observable events which can be proved correct or incorrect. In other words, everyday thinking is viewed as governed by efficiency rather than the full and systematic consideration of alternatives (Rogoff & Lave 1984). Thus, it is explained that knowledge utilized for practical problem solving in everyday situations would be tacit knowledge, that is, knowledge available in the relevant setting rather than by relying on explicit propositions. In the same way, Mezirow refers to knowledge as being deduced from rules of value systems and from rules of investigation.

In turn, I would contend that everyday thinking, or what is termed instrumental learning, is governed by both efficiency and a systematic consideration of alternatives. Therefore, I consider that efficiency would be linked to the contextual constraints. The analysis of the processes of knowledge constitution in the workplace gives a good opportunity to examine this issue. I have analyzed cultural constraints in previous chapters regarding problem solving at work. Instead in this chapter cultural constraints have a different meaning. Rather than constraints, social influencies are to be seen as the psychological subjects' engagement and relatedness with the world.

On the other hand knowledge in work-related tasks is seen through the subjects´organizing activity of the situations as interfaced in a particular social setting. Thus, I stress the constructive activity of the subjects and the assimilating progressive character of everyday knowledge.

In any case, everyday knowledge interpreted as instrumental learning, may rapidly be transformed into contextualized knowledge. That is, knowledge then becomes bound to the content and the situation from which it was deduced or acquired. In this respect, such a determinism leaves fairly little room for the subject´s activity. As this study focuses on adult illiterates this aspect is extremely relevant. In Chapter 1 I have introduced the incongruences I see in *Educación Popular* on this aspect. Educational practices aim at fostering adults' developmental autonomy but often treat them in educational settings as if they were inexperienced in curricular contents. In some cases this occurs as a consequence of openly assuming an empiricist position on learning. In others, this contradiction appears as a result of the inability to design educational practices based on subjects' experiences. For the latter the analyses I present will probably make sense as I see experience as the main source of learning.

Studies focused on reversibility and transfer in the schema of proportionality and developed in everyday contexts (Nunes & Schliemann & Carraher 1993, 103-26), present a different perspective for considering everyday knowledge. They proved that the concept of proportionality, learnt in everyday practices, can be applied in new situations. Thus, this result contradicts the hypothesis that everyday knowledge may be so entangled with situational relations that it cannot be applied in other situations or social settings.

> These results clearly contradict the idea that street mathematics is the product of concrete thinking and that it generalizes poorly. Both flexibility and transfer were more clearly demonstrated for everyday practices than for school-taught proportions algorithm.(...) It seems that everyday procedures, which are likely to be already available to students before they are taught the algorithm, compete with the algorithm. The conflict stems from the fact that the everyday knowledge uses calculation procedures in which variables are kept separated (Nunes & Schliemann & Carraher 1993, 126).

I shall analyze work-related situations in which the action that mediates the interrelationship between the subjects and the objects or situations appears systematically as a transforming action, through the assimilating and accommodating processes.

I shall present some cases where it is possible to observe some logical-mathematical and physical-chemical knowledge that adults with little education possess, as well as how they use it. The exploratory character of the present study permits me, in this context only, to stress some evidence. For the analysis of this category, I shall consider some specific practices within the following work contexts: domestic work, building work and rural work.

7.1 Housewives and domestic workers

The housewives and domestic workers studied were interviewed in their homes or in their workplace. Within their everyday activities, I asked them to describe the procedures for preparing preserves and for knitting. For the first work task, though they could choose whatever preserves they wanted to tell about, they spontaneously decided to tell about the preparation of jam. What varied from case to case was the type of fruit used, e.g. pears, apples, quince. I have chosen simply to analyze the preparation of jam. In any case, there was no substantial variation observed in the procedures and knowledge for preparing jam with different fruits. On the contrary, they reinforced and brought out the same evidence.

Before conducting the final interviews, I looked into the proportions for different jams and the characteristics e.g. the quantity of sugar per kilo of fruit, water, the simmering time, and the like. I attempted to obtain general information about the knowledge involved in the interviewees' everyday activities. The interviews were then conducted using clinical criteria *(see methodology in chapter 4)* trying to problematize the procedure for the subjects during the description, allowing them to show how much they knew.

Fourteen women were interviewed who had school experience ranging from none to four years during their childhood[77]. The following is a case which may serve to analyze the knowledge involved in preparing apple jam.

a) Case 8: preparing jam *(Mónica, 6.2.a.4)*

> *Mónica is 27 years old. She attended school as a child until the 2nd grade. She works as domestic help and lives in the zone of the "chacras". The interview was conducted in her house.*

---

[77] For the characterization of the sample considered, see the tables presented in Appendix I.

> *I: Let's see, how do you prepare apple jam?*
>
> *S: Well, I peel the apples, Granny Smiths, they are the green ones. After that I just cut them in pieces and pass them through the meat grinder. Then I put them on the wood stove because the gas is consumed very quickly, and then I let it simmer slowly. And when it has simmered, more or less, two or three hours, I put the sugar into it.*
>
> *I: How much apple do you use?*
>
> *S: Well, some three kilos of apples.*
>
> *I: And for that many kilos of apples, how much sugar do you use?*
>
> *S: One and a half kilos if they are green, if they are red, one kilo, because the green ones are always more acid.*

Mónica was interviewed in her house and the description for preparing jam should be seen as for her family's use rather than for an employer. This distinction is important because of the availability of different equipment depending on whether she is preparing the jam for her own use or for her employer. In each case the strategy and the meaning of the situations is different. It is difficult to imagine that Mónica would find a wood-burning stove in her employer´s house to prepare jam. Furthermore, the preparation of jam in both situations acquires different economic meanings. In other words, when preparing it for herself she prefers to use a wood-burning stove instead of gas, both because of the scarcity of gas and its expensiveness in rural areas, and because of the possibility of replacing gas with a wood-burning stove.

Consequently, when referring to the simmering time, she makes an approximate estimation, i.e. two to three hours. However, the absence of exactness for measuring the simmering time may be due to the difficulty of maintaining a constant temperature on a wood-burning stove.

A distinction was made between two varieties of fruits, i.e. green and red apples, to define the quantity of sugar to be used. She applied different proportions in each case. Thus, the distinction she makes between the two apples is not just a question of colour but of chemical constitution. What Mónica refers to is the acidity-sweetness relationship considering the properties of the materials she uses for the case. Further, she relates these properties to the amount of fruit and the amount of sugar required to perform the task. The next paragraph of Mónica's interview shows how she deals with proportions when the interviewer changes the quatities of fruits.

> *I: You said that you use 3 kilos of green apples and one kilo and a half of sugar.*
>
> *S: Yes.*
>
> *I: And what if you use more apples, for example five kilos of apples?*
>
> *S: For example, for 5 kilos of apples, you should add about two to two and a half kilos of sugar.*
>
> *I: If you'd like to make less jam, how would you do it?*
>
> *S: Less jam...less apples and less sugar, too. One kilo apples would need half a kilo of sugar.*
>
> *I: With 3 kilos of apples and one and a half kilos of sugar, how much jam do you get?*
>
> *S: Well, when I made it I got eight jars.*
>
> *I: Eight jars of how much?*
>
> *S: That I don't know, whether they are half kilo jars or whatever. I don't know. I got eight jars, big and small ones.*
>
> *I: And if you were to use one-kilo jars?*
>
> *S: There'd be less. There might be two to three jars.*

I: And if you'd put it in half-kilo jars?

S: Well, there might be 4, 4 or 5.

We could see in this paragraph that Mónica had no difficulties whatsoever in answering correctly when one of the terms of the proportion was changed. However, I am not aware of the procedure used by Mónica for giving the correct answer. I presume that she could not use a scalar solution[78] because she was asked about 5 kilos of fruit instead of 6. That is, she could not find the correct answer by carrying out parallel transformations on the variables, thus keeping the ratio (3 kilos of fruit - 1.5 kilos of sugar) constant.
Instead, I think that she found the answer through applying a functional solution, that is, by finding the fruit-sugar unit ratio (1 kilo of fruit - 0.5 kilos of sugar) and using it to calculate the desired value. What should be noticed is that the answer was given orally, without the support of paper and pencil. The same occurs when she is asked about diminishing the quantity of fruit. She applied proportionality in giving the answer.

Then I switched the questions in the interview to change the variables in question. That is, instead of considering the fruit-sugar relationship, I asked Mónica about the fruit-jam (unprocessed-processed) relationship. She used the jars to refer to the jam produced instead of expressing it directly in kilos. This must be interpreted as the jar being her reference for measuring the jam. However, though she could not fix the relation kilos-jars, she could still answer correctly, applying a scalar solution when I fixed the size of the jars to one or half a kilo.

---

[78] For a distinction in the strategies used for solving proportion problems see: "Reversibility and Transfer in the Schema of Proportionality"; in Nunes & Schliemann & Carraher 1993. *Street Mathematics and School Mathematics.(103-126)*

The next part of the interview shows us how Mónica dealt with physical-chemical transformations and equipment.

> *I: How do you know when the jam is ready?*
>
> *S: By the colour and the form it has. Because it becomes light brown in colour and it doesn't have juice any more, the water from the apples, when they are simmering. It gets dry.*
>
> *I: About how long do you simmer it?*
>
> *S: Well, sometimes for five hours.*
>
> *I: What happens if you simmer it for less time?*
>
> *S: It doesn't turn out well. It depends, because if you cook the apples cut into pieces, it takes more time until it is all mashed. Now, if you grind them, if you pass them through the machine, you know, it takes less time.*

The relations between colour, form (as she expresses the density of the jam) and the simmering time involve chemical processes and transformations during the cooking process. The process of dehydration, occuring in the apples when put in contact with the heat, is observed by Mónica. She presents the relation between the time of simmering and the way the fruit is cut. Then she refers to a piece of equipment. That is, she compares the difference between using or not using the machine for grinding the fruits. I point this out because the piece of equipment, in this case, leads Mónica to anticipate different simmering times. So, another variable is added to obtain the proper fruit dehydration. Thus, whether she expresses and figures out the situation, she shows some physical-chemical knowledge. That is, she makes explicit cause and effect deductions in relating different variables.

b) Comments

In the case of Mónica we could observe the different variables she explicitly takes into account for preparing apple jam: The amount of apples, the properties of the apples, the amount of sugar, the simmering time, and so forth. In relation to the apples, she establishes differences according to the variety, green or red and she sets that difference in relation to the amount of sugar. As to the simmering time, she relates it to how the apples are cut and then to the colour and density of the jam.

In addition to Mónica's description of the variables she takes into account and the relations she establishes between them - which reveals a structuring of the data - we can observe her knowledge of weight measures and the number system as well as the physical-chemical dehydrating process.

It might be possible to imagine that all the quantities Mónica used for preparing jam were simply the application of a cooking recipe. However, when she was asked for quantities other than those she had initially presented, she revealed, not only the notion of proportionality, but also the capacity to reorganize the data from the recipe she might have learnt. Preparing jam is for Mónica a routinized activity but however she was able to put it in words and explain step by step the different alternatives available. Can we say then that routinized activities are simply mechanical ones? The case we have gone through at least shows a very interesting structuring activity by the subject which as such cannot be reduced to mechanical nor to context-bound actions.

Finally, I would like to point out that this case shows both particular knowledge learnt and utilized in out-of-school settings, and a systematic display of steps and interrelationships between the intervening variables to develop work-related tasks.

7.2 Building workers

The building workers were interviewed about the construction of an *ochava,* as they term the construction of an octagonal corner. During the exploratory stage I interviewed some of the subjects about the preparation of concrete and rough-cast. But in conducting the final interview, I asked them to tell me about the construction of an octagonal corner. Only in those cases in which the subjects stated they could not comment on the construction of an octagonal corner because they had never dealt with them, they were asked instead about concrete and rough-cast preparation. There was only one case that fell into the latter category.

In conducting the interview, an observer recorded the graphic descriptions suggested by the subjects. Paper and pencil were not provided and the explanations were given by the subjects about concrete work. When the subject himself found it necessary to give a graphic description, the ground was used. I interviewed 10 building workers with school experience ranging from none to four years.[79]

In constructing the octagonal corners they use a formula (see Figure 12.) that varies from worker to worker or perhaps from one particular social setting to another. Nevertheless, the variations I observed were not in the formula itself, but in the numbers used for expressing the relations.

---

[79] For a characterization of the sample see Appendix I.

These formulae could be viewed, for example, as tacit knowledge available in and provided by the cultural practice in which it is being applied. However, the case I shall go through shows the utilization of mechanisms, if not to validate their knowledge at least to grant them usefulness.

The following case shows very clearly the knowledge involved in work-related tasks and the mechanisms used for applying that knowledge.

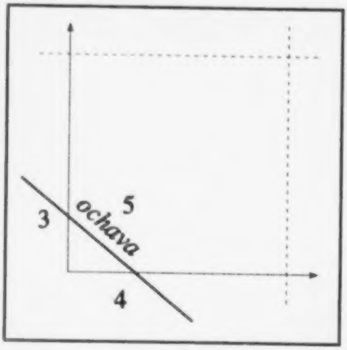


Figure 12. Octagonal corner of a house.

a) Case 9: Building an "ochava" *(Lorenzo, 6.2.b.10)*

> *Lorenzo is 49 years old. He attended school as a child until the 2nd grade. He has been working as a building worker for many years. Though he doesn't have a permanent job, he does work on contract.*
>
> *I: Well...why don't you tell me, Lorenzo...?*
> *In making the "ochavas"... What do you do?*
>
> *S: Well, it's very easy. You look for the square. Right?*
> *The square is the same on one side as on the other...You know the measurement of the "ochava", right? Like the corner.*
> *So much for the back and the same here. And there it crosses.*
> *That is, it crosses the "ochava". Then it has to work out. If this is in a square, of course the "ochava" has to work out.*
>
> *I: And how do you make...? I mean, if this forms a square, how do you know that the other one forms a square?*

S: Well, because of the line-up of the stakes...How is it? It may be municipal...The stakes are there to guide you.

I: That's good.

S: You put down one stake here, another one there, right? And this is the guiding one and that's it. If you have 6 metres along here, you have 8 there, it has to give you 10 here. That's the form.

The construction of an octagonal corner does not seem to present great problems for Lorenzo. He is aware that the square must be created first. This means that an angle of 90 degrees must be set, though he does not refer to it with that name. In this regard, he explains that in order to know the measurements of an octagonal corner the leading stake should be determined. He refers to the leading stake as the vertex from which he can apply the measures. However, when he was asked how he knows that a square had been created, he justifies it by referring to the municipal stakes. This does not actually explain how a square is created.

The municipal stakes, that mark the limits for building, are used in this case as determiners for applying the measurements, in other words, to delineate the exactness of the square. When Lorenzo refers to the measurement 6-8-10 in his explanation he does not present them just in any order, but in the correct order. What he is doing here is that he is using a kind of formula, and also applying it correctly. That is, he measures from the leading stake 6 on one side and 8 on the other, to obtain 10 on the third side. These measurements, though provided by the social setting where he works, are interpreted by him not only for developing work-related tasks but for explaining about the square, as in the interview I am analyzing.
I shall present the next paragraph of the interview where I change the measurements in the formula initially presented by Lorenzo.

I: I have been told that there is a formula they use for making the "ochava" that's called 3-4-5. Do you know it?

S: Well, no, no, until now, no. I don't know why it's 3-4-5?

I: The truth is that I don't know it very well, but I've been told about...

S: 3 like this, 4 like this and 5... I don' know...it might be.

I: How would you then tell me it is?

S: But if you have 3-4-5, one part may be shorter on one side than the other...

I: Let's see, how does that work?

S: Of course, for example. If 6-8 and 10 are exact, it's because that makes a square, right?

I: 6-8 and 10?

S: Of course. 6-8...it has to be 10 here, doesn't it?
Because it's a square. Now...

I: How do you know it has to be 10 here?

S: Well...because if you take a paving tile, let's suppose, and measure it...I don't think the paving tile is an out of true square.

I: No

S: Well, I don't think the wall tiles are either.

I: No. That's true.

S: Well, if you measure this, and then you measure this, that gives you 10 cm, let's say, from here to there; where you mark if off it is the same as this...If you measure 6 cm here, 8 cm there. Right?
What it gives you there...then you know if it is a square or not.

We must observe that when I presented the same formula but with other measurements he could not immediately relate it to the one he uses. And the first reaction was to point out that by applying 3-4-5, one of the sides would be shorter, as if it were different when applying 6-8-10. I might interpret that this answer denotes that Lorenzo was not aware of the relation of measures that he presents with the formula 6-8-10. Thus, rather than understanding the tool he uses, i.e. the formula, he just applies it mechanically. The possibilities for Lorenzo to adjust a square seems to be exclusively related to the learnt formula. However, what is not entirely consistent with this interpretation is that he still insists, in this paragraph, to justify the relations and exactness of the measures 6-8-10. He now does it, no longer by using the explanation of the municipal stakes, but instead by referring to the paving tile to prove his thesis. Though the paving tile is quite common in building work, it is not necessarily used for building an "*ochava*". Consequently, Lorenzo is transferring to another content a formula learnt to be applied in building an "*ochava*". He is empirically proving a thesis learned and applied in a certain situation and applying it to another situation.

I shall present the next paragraph of the interview where I brought back the formula 3-4-5 that Lorenzo could not initially relate to his own.

> *I: So then...the formula they had told me was 3-4-5*
>
> *S: Ah...It's the same, it's clearly 3-4-5. It's the same, it must give you a square in the same way.*
>
> *I: Lorenzo, so you learnt this in practice?*
>
> *S: Study, I couldn't study, so...*
>
> *I: Well...Are you sure that they always are in those proportions, you cut 6 here, 8 here, and it is always 10 there?*
>
> *S: It's logical, as it can be 12-16 and 20, right?*
>
> *I: And why do you think it always is like that?*

> *S: Well...because...it's an exact measurement.*
>
> *I: I see.*
>
> *S: It's an exact measurement for a square. Of course. And if it is not squared, everything will be in out of true square, even the roof, and the floor, everything will turn out to be an out of true square. Where the floor is put in, it will turn out wrong, and where the roof is made, for example of zinc or whatever, it will turn out badly. Well, that's it.*

Now Lorenzo could realize that the formula 3-4-5 is the same as 6-8-10, in that both make a square. This is quite important because it is clear that he is applying proportionality. He used a scalar solution and could present still another way to calculate a square, i.e. the formula 12-16-20. What he could not explain was the mathematical relation that makes these formulae, with different measurements, result in a rectangular triangle.[80]

In this dialogue, Lorenzo concludes the clarification by saying that it is an exact measurement, and cleverly remarks that it is in the exact measurement for a square. That is, these formulae would not be exact for constructing an obtuse angle of 95 degrees. Then he went on to explain the contrary. He describes the consequences when starting with a false square. What he shows is that a global view of the whole activity is taken into account. There is a structuring of the situation, as well as an identification of the conditions.

Throughout the dialogue presented, Lorenzo gave quite remarkable validations for the formula he uses, i.e. municipal stakes, paving tiles, different measurements and the consequences of an out of true square. Though all these are empirical justifications, I understand they denote not only the organizing activity of a subject but the proportionality notion and the geometrical notion of a triangle with a right angle. Furthermore, this knowledge and cognitive activity does not seem to be tied to the particular task from which it is deduced.

---

[80] I invite the readers themselves to explain this formula mathematically.

b) Comments

In the case of Lorenzo, a systematic and structured display of steps is observable. For the construction of an octagonal corner, he presented a basic formula. Whether or not he is aware of its formal mathematical deduction, Lorenzo could give evidence of its application and how it functions through a particular empirical validation. He did so by explaining that if the measurements 6 and 8 were maintained for two sides of the square, the third side would always be 10, in other words, the crossing of the "*ochava*". Afterwards, he justified it by arguing that these are exact measurements and that this can be verified with a paving or wall tile, starting from the idea that both a paving tile and a wall tile are trusty empirical references due to their exact size. Furthermore, throughout the interview we could observe how Lorenzo applied the principle of proportionality. He concluded by affirming that to prevent an out of true square, one may use the measurements 3-4-5, 6-8-10 or 12-16-20.

Finally, the case of Lorenzo shows that this is not a mere mechanical application of rules. Rather, an organizing activity for correctly using the information provided by the particular social setting is observed. In addition, the structuring of the whole task, by anticipating the effects that would follow if he were to fail in determining the square, is evidenced.

7.3 Rural workers

The rural workers were interviewed about the pruning of fruit trees. I visited their workplace, to enable them to describe their activity within the real setting of their everyday work. During the exploratory stage the rural workers interviewed were asked about different activities they carry out. It is quite common for those who have a steady job to carry out all kinds of activities on the farms according to the season. Those who work on contract develop specific work-related tasks. One activity, for example, mentioned by the subjects was the participation in the curing of fruit trees, in which they deal with mathematical proportions. This activity is interesting because they apply proportions with quite large quantities, showing an approach to the numeration and measurement systems that is different to the ones observed in domestic and building work. However, to conduct the final clinical interview I decided to focus on fruit tree pruning because I found that this work practice allows for the consideration of other kinds of knowledge related to natural sciences.

I interviewed 8 rural workers, but only 5 in particular were asked to describe the pruning of fruit trees. Due to the characteristics of the region, where the main production is apples and pears, knowledge about pruning is well developed in relation to these fruit trees. This kind of knowledge may be viewed as irrelevant because it implies quasi-obvious phenomena easily understandable by observation. However, in this work activity variables, such as the wind, the sun, and the characteristics of the fruit trees, intervene that can not be modified by the subject but must be taken into consideration. The particularities of such variables require some knowledge of the effects that result when they interact. I shall present a case of a rural worker employed on an experimental farm belonging to the *Instituto Nacional de Tecnología Agropecuaria*. Despite the employing agency the interviewee had not received formal instruction concerning the pruning of the fruit trees.

a) Case 10: Pruning fruit trees *(Solorza, 6.2.c.17)*

> *Solorza is 60 years old. He attended school as a child until the 2nd grade and works as a rural worker in a "chacra" of the Instituto Nacional de Tecnologia Agropecuaria.*
>
> *I: Why don't you tell me a little about how to prune?*
>
> *S: Well, let's see, this is a small plant that you have to form. Let's see, this is left for shade (shows a branch), for fruit, do you see? Because if you peel all this branch, the sun burns all the fruit, it burns the fruit...*
>
> *I: How is that, Solorza?*
>
> *S: Let's say that I have here an apple. That apple gets all the sun directly from the front, it's no good for you if it gets burnt by the sun. With a little bit of shade here and here, then it's different...[...] These are buds (shows buds), do you see? This is a little bud, this gives flowers here and then it gives apples. This is left like that, without cutting the point.*
>
> *I. Why are there some short branches and some long ones?*
>
> *S: Well that's because...there was a branch. But when the tree was pruned here, since that was not cut from the point, it became a bud. When you cut the point here, a little hook sticks out, then no buds will be developed there.[...] Let's say, you leave this one uncut, from here on up (he indicates from the beginning of a branch to a point more than halfway along), it doesn't give you anything. Just from here on up it gives you fruit. Just above it gives fruit, then what good is this branch? You have to cut it here so that it starts budding later.*

The reasons for cutting or not cutting a branch vary from case to case while developing pruning. Solorza presents one of them here: the effect of the sun on the fruits. In this context, he cannot mechanically apply the rule derived from this phenomenon to any tree. He refers to a small plant that needs to be formed. I failed to ask him to explain why the fruit would be damaged by the sun and not the branch and the

BEST COPY AVAILABLE

leaves that produce the shade. However, he seems to consider a different effect of the sun upon the leaves and the fruit.

Furthermore, he specifies where the branches should be cut. This does not seem to be random either. Instead, he gives reasons for defining whether, when and why to cut a branch. Solorza gives a detailed explanation for justifying that it is useless to leave a branch uncut as it does not produce as much fruit as it could if it were pruned later. Let us continue with the next part of the interview in which I asked him about the effects of the wind on the pruning.

> *I: Other people have told me that the wind has something to do with the pruning.*
>
> *S: Of course, a free plant, like this one (he shows an apple tree on a traditional plantation, not cordoned), that is not tied with wire, you prune it in a different way. You always cut it from the bud upwards, and the bud goes out, always against the wind, then it grows against the wind. Because if you don't, the plant always goes with the wind.*
>
> *I: And what happens if it grows towards the wind?*
>
> *S: Because the wind bends the plant a lot, it can turn the plant over... Then to put it upright again, you have to put in a pole, because, well?...On the contrary, if you continue pruning and you make it grow against the wind, you do not need to put in a pole and it gives it support.*

In this dialogue he brings up other element that influences the pruning. That is, whether the pruning must be done on trees developed in the traditional plantation way or those cordoned. The traditional plantation way requires a different type of pruning. In this case, the effect of the wind plays an important role that must be taken into consideration in deciding how to prune. He explains that it depends on the way the branches are cut whether it might be necessary later to use a pole to counter-act the effect of the wind.

b) Comments

In the case presented above I observed some interesting clarifications about the pruning that revealed the anticipating activity of the subject for developing this work-related task. Solorza presented differences depending on whether the type of plantation is a traditional one or cordoned off. This differentiation in itself could simply mean two different types of work-related tasks. However, this reveals the structuring of the information, and therefore of the task.

He considers, in the case of a traditional plantation, that the cutting of the branch must be made at the height of the bud and outward, that is, against the action of the wind to promote the growth of the plant in that direction. Thus, this has an effect on the resistance the plant may offer to the force of the wind. Then, he contemplates the possibility of exercising that resistance by supporting the plant with a pole, however, he understands that if the plant were pruned in the aforementioned manner the pole might be avoided. This strategy, as stated by Solorza, might be valid for the reference zone, that is the *Alto Valle*. In other geographical regions, with more intensive winds and without forest protection, perhaps the resistance that the plant growth may exercise with this type of pruning might not be sufficient to counter-act the wind force. But what is of interest in this example is the physical notion evidenced in the relation made between the force and resistance.

From the explanations presented in the example I understand that Solorza, while pruning, does not cut the branches in an unforeseen way or simply by approximation. Instead, an internal decision scheme exists concerning what to cut and what not to cut. Therefore, the decision involves a system of knowledge about the plant, its functions and cycles of development and also of the climate.

7.4 Summary

In this chapter I have analyzed the empirical evidence by presenting some typical cases. In doing so, I have developed a theoretical interpretation from Piagetian theory on the cases being analyzed. The cases I have offered show evidence of the knowledge utilized by subjects with little schooling for developing certain work-related tasks. In this sense, logical-mathematical and physical-chemical notions were revealed. Furthermore, I have shown that these notions are not mechanically applied but rather through a systematic organizing activity of the subjects. In other words, the epistemic subject described by Piagetian interpretations is revealed in the examples presented as a psychologically active subject.

Finally, I would like to point out the intricate relationship I found between task-oriented problem situations and the processes of knowledge constitution at work. I have discussed (see Chapters 2 & 3) the explanation that conflicts play a central role in developing cognitive structures and I have also shown empirically and theoretically that adults with little schooling construct knowledge at work. The knowledge constructed in informal settings may be developed and potentialized in formal settings. We come then to the problem of pedagogical intervention. In this respect, I contend that a characterization of task-oriented problem situations at work and the knowledge involved in work-related tasks constitute interrelated perspectives of analysis for reaching an understanding of problem situation designs.

In the next chapter I shall review my research in relation to different theoretical positions. Finally, in Chapter 9, I shall present the conclusions of the study.

8 - RESULTS AND CONCLUSIONS

The development of interdisciplinary studies is needed to find an interpretative framework which can prove useful to address the object of research. I cannot characterize the present study as interdisciplinary but indeed the theoretical framework has its underpinning in an interdisciplinary theory.

In this study I have interpreted the framework as an epistemological-psychological unit of interpretation finding theoretical backing in Genetic Epistemology and Psychology. In fact, Piagetian theory evolved by constantly matching epistemological and psychological issues and using a variety of empirical references. However it is not the only way of defining a unit of interpretation. I see Genetic Epistemology and Psychology as necessary conceptual tools for developing interdisciplinary studies aimed at generating some impact on social practices. Educational research at any level is located in practice as a social practice and consequently involves interdisciplinary cooperation.

Discontinuities among the epistemological, psychological and pedagogical levels, in the case of *Educación Popular,* led me to define a theoretical interpretative framework to conduct the study and find out some answers to the problem. That is, to study an educational issue I moved out of school to get empirical evidence which may prove useful to educational design. A further step is to use the same scheme based on the empirical analysis done in out-of-school settings to work out an educational proposal. Using the same scheme is to extend the epistemological-psychological unit of interpretation to the pedagogical sphere.

This task finds obstacles in educational demands which are usually tied to the requirement of immediate answers. However I strongly believe that educational reality and needs must orientate the search but never dictate the way of doing it. Teacher training plays a crucial role in any attempt to work on the pedagogical level and it is referred to as the bridge for implementing psychological findings as educational practices. I find that it is in the bridge where discontinuities start to come about. What is needed is the full integration of psychological findings into educational practices in order to achieve a better understanding of the process of knowledge constitution and problem solving.

8.1 Everyday knowledge and literacy

The term everyday (activities, practices, knowledge, etc.) is heavily impugned with negative connotations emanating from its definition in contrast to scientific thought. The customary use of the term everyday world encompasses an unsung category of humble work-related activities and their associated social roles (e.g. domestic work, building work, rural work). This view does not pay attention to the processes which may constitute the everyday world. Instead this view has constrained practices by creating limits and reducing them to a functional package suitable for researchers' own purposes.

> Everyday is not a time of day, a social role, nor a set of activities, particular social occasions, or settings for activity. Instead, the everyday world is just that: what people do in daily, weekly, monthly, ordinary cycles of activity. A schoolteacher

> and pupils in the classroom are engaged in everyday activity in the same sense as a person shopping for groceries in the supermarket after work and a scientist in the laboratory (Lave 1988, 15).

It is actually the routinization processes which over time shape a particular set of events in a particular setting transforming them into a class of events characterizing the everyday. The processes of knowledge involved in everyday practices share essential constitutive mechanisms whether in formal or informal settings.

The presence of context-based characteristics intervening in the process of knowledge constitution does not lead to a sharp distinction between different settings. Differences might appear on the way of describing development and learning but nevertheless both concepts are overlapping each other and no limits can be drawn between them.

I shall not dwell deeply on the distinction between formal and informal settings though it is indeed important and needs clarification. I refer to them by differentiating organized and intentional educational processes from work-related learning processes. I relate them from the Piagetian point of view to learning in a strict sense and learning in a broad sense[81]. These are processes which acquire and result from different interactions between subject and reality but altogether constitute the single process of development.

An important issue then is to consider the possible continuities between formal and informal settings. I do not reduce the idea of continuity to uniformity at all. Uniformity in the processes would on the contrary not allow continuities to come about. It is impossible to find uniformity in the processes of knowledge constitution at work and at school because they take place in socio-historically differentiated settings. But however continuities in the processes of knowledge exist and must be focused on when planning learning sessions.

---

[81] See Chapter 2 for the analysis of the differences between leaning in a strict sense, learning in a broad sense and development.

Adult education in general relies very much on participants' previous experiences. It is familiar to any adult educator to talk about participants' experiences and the need to use them as a source of knowledge for critical reflection. The previous, the actual and the possible are central aspects in any learning process and refer to continuity of a developing subject. There is no educational design which could break developmental continuities and by meeting them the learning process is optimized. Continuity in experience does not mean a lineal extension of lived experiences. It means empowering adult students with new experiences which enrich by contradicting or supporting earlier ones.

Focusing on mathematical learning or reading and writing which are central objects of any literacy plan in adult basic education, the continuities to discover are related to the levels of construction the participants have of these objects. In the case of people with little or no school experience the levels of construction and the ways of construction are to be found in out-of-school practices. Afterwards educational design should meet participants' earlier ways of performing in reality to optimize the learning and not to overlook the learner by imposing teacher-centred strategies.

8.2 Unifying dichotomies

Dichotomies generally work as obstacles to advance on certain issues. However at the same time they also play an important role in developments which call for unification and further synthesis. Regarding the concern of this study I should like to point out particularly two different but interrelated dichotomies operating in studies focused on development and oriented towards educational instruction. The first is the relation between knowing subject and knowing object and the second is the relation between problem solving and the constitution of knowledge.

8.2.1 Knowing subject / Knowing object

Adherents to the interpretation of a cognitive relation between two natural systems believe that the defects of empiricism are not determined by the interaction between knowing object and knowing subject but by a one-sided view of such interaction. Empiricism studies the action of the object on the subject but not the reverse action: that of the subject on the object.

Piagetian theory offers an alternative perspective breaking this dichotomy. Both sides intervening in the interaction are studied but in interaction, not as isolated systems but in their dialectical relationship (Piaget 1970/85). Action is a central concept in Piagetian explanations. Action transforms both the subject and the object. There is no determination of one by the other.

Criticism of Piagetian theory points out that his interpretations do not break the dualism of subject-object knowledge even while focusing on their interaction. It is argued that this relation is not enough to explain knowledge constitution as it leaves out other cultural-related aspects intervening in the process. However, this criticism recognizes in Piagetian based cross-cultural research the struggle to identify cultural influences in cognitive processes. However such critics (Saxe 1991) argue that Pigetian relations between culture and cognition help to identify only external connections but not intrinsic relations whereby cultural and cognitive developmental phenomena are constitutive of one another.

Certainly Piagetian theory remains open and unfinished and the relation between culture and cognition needs further development. However I believe Piaget has left a good basis for developing this aspect which often is not acknowledged by adherents to culturally-oriented perspectives.

Piaget has long talked about knowledge by explaining the relation between knowing subject and knowing object; a relation that can be interpreted as disembodied and free from contextual influences. However as soon as one goes into detail into the explanations given by Piaget one finds at least contradictions in the argument that Piaget does not consider socio-cultural influences in explaining knowledge.

Objects of knowledge represent a constructed reality and the subject of knowledge represents a developing subject; both are a product of their mutual contributions and interactions. Objects are never isolated entities but socio-historically situated and constructed. The same applies to the subject of knowledge. Piaget in one of his last books (Piaget & García 1982) when explaining the position of the objects of knowledge uses the terms objects and situations interchangeably when referring to the situation where the objects occur.

8.2.2 Problem solving / constitution of knowledge

The division between performances like problem solving and the constitution of knowledge leads to other divisions like subject and developing subject. Problem solving performance is constitutive of knowledge formation. Conflicts as products or agents of change are also constitutive of development.

The separate treatment of these issues probably makes the transference of psychologically-oriented research to educational instruction easier but conveys a serious epistemological discontinuity. Knowledge constitution cannot but be explained through the indisociable relation between the subject and object of knowledge. This interactive relation involves resolution of different kinds of conflict in the process of knowledge constitution.

Within the frame of Information Processing Theory, for instance, the activity of the subject compared with that of a computer takes place in the interior of a computer. In Piagetian theory the activity is not separable from the knowable reality. The epistemic subject and the epistemic object in Piagetian terms cannot be interpreted apart from the essential relation they hold. The dichotomy seems to take either the shape of subject-laden or object-laden focus, finding the basis for dividing performances. Knowledge analyzed separately from its constitutive mechanism unavoidably falls into an empiristic determination of the epistemic interrelationship between subject and object of knowledge.

This kind of epistemological discontinuity operates against any possibility of transference from psychology to education. The use of epistemological-psychological units of interpretation prevent the disconnected treatment of "issues" which might constitute interesting areas of research but help little in improving educational practices.

8.3 Summing up results

In what follows I shall summarize the main results achieved with respect to the empirical analysis. In doing so, I stress those aspects in which I find relevant syntheses to characterize the processes of knowledge constitution in work-related situations and to further studies in educational design, particularly in relation to literacy programmes.

(1) The work-related practices developed by the subjects do not only imply mechanical actions of manipulation or simple practical abilities. They involve an important structuring activity, on the part of the subjects, in problem solving and in knowledge constitution. In this sense, I want to stress the evidence that work-related practices, as particular social settings, facilitate the construction of knowledge for the workers. This goes beyond the level of formal instruction.

(2) I identify throughout the distinct situations of the three elements as constituents of task-oriented problem situations: the problem solver, the objective elements of the situation (OES) and the social context. These elements have a direct influence upon the successful procedure used in the solution and define the particular type of problem situation. Thus, they should be taken into account when designing problem situations.

(3) The interactive process between the constituents is interpreted as the basic dynamics of a task-oriented problem situation. The successful procedure is characterized by a narrowing process from the broad field of given possibilities to the success area. Within the first, different strategies can be anticipated though they will not necessarily prove successful. Success in the strict

sense means that the problem solver, the OES and the social context are mutually constrained within the success area.

(4) The subjects appear as protagonists in problem solving processes. Thus, they constitute empirical evidence of an active epistemic subject in a particular context such as the workplace. The active role of the subject is revealed in the structuring, ordering and anticipating activity the subjects develop in the distinct work-related tasks investigated.

(5) The characteristics of the intervening objective elements of the situation define different problem situations according to the possibilities for reinstating the solving procedure using the same materials. It is only possible to reinstate the situation when the intervening materials do not lose their essential characteristics. On the contrary subjects are forced, through rigorous anticipation, to develop a successful procedure. Consequently, both the characteristics of the OES and the actions the subjects develop towards them, i.e. whether logical-mathematical or physical-chemical, define different types of problem situations.

(6) The particular social context in which the situation takes place, may or may not determine the success of the task at the same time as it defines it and signifies it as a problem. Some strategies may be considered successful in one context and not in others. So the solver's activity is constrained in the task solution by the acceptance or not that the context demands to certain solving procedures.

(7) Routinized processes are characterized by the interrelationship between subjects' activity and content-related activity over time and space. Routines are domain-related processes

sociohistorically construed which involve general and particular rules. Routine stability gives the basis for performing work-related tasks. However stability does not mean immutability. Variations in routines are introduced by modifications in the general and particular rules that structure routines. General rules are linked with the work-domain as basic instruments and techniques accepted for determining certain work practices.

(8) Task-oriented problem situations may lead or may not lead to displacement of equilibrium in Piagetian terms. In the first case the routine gives the basis for solving the problem (reaction alpha). In the second case neither general nor particular rules within the routine are enough to solve the problem and consequently it is necessary to restructure the task with displacement of equilibrium (reaction beta).

(9) In the work practices considered in this study the subjects revealed that they had constructed certain knowledge, such as proportionality, measuring systems, certain geometrical notions and physical-chemical transformations. This knowledge cannot be reduced to the degree of well-handled techniques applied to very particular situations and bound to them. But instead, they involve concepts developed by interacting within certain social practices. I stress the constructive activity of the subjects and the assimilating progressive character of everyday knowledge.

8.4 General Conclusions

Research in adult education should meet the needs arising from educational practices more closely. In this sense I find it necessary to look at source disciplines not only in social sciences but also in natural sciences to conduct research focused on adult educational practices. Adult education cannot be developed further unless it goes hand-in-hand with general education. This is particularly relevant in the case of basic adult education and literacy programmes.

a) Piagetian theory

Piagetian theory with its epistemological and psychological dimensions proved useful in addressing educational-related issues such as the constitution of knowledge in everyday practices. Piagetian central theses of constructivism, interactionism and equilibration as explicative process give a good basis to develop understanding of adults' cognitive performances.

I have presented some results that reveal that subjects with little schooling and performing work-related tasks display sets of actions structured by the organizing activity of the task. An active subject is revealed in the constructive and interactive activity evidenced when developing work-related tasks.

Work-related tasks are actively developed by the subjects, if not relying on explicit propositions, at least with a huge awareness of what they are performing. Workers, as I have tried to show, develop an organizing cognitive activity when solving task-oriented problem situations. The utilization of information available in the social setting is observable according to the particular work-related task. However, I interpret it as the assimilatory process that the subjects experience when interacting with given objects or situations. There is a transformative process at work on both the subjects and the situations intervening in the developmental processes and knowledge constitution. Therefore, the information is assimilated by subjects' cognitive structures and accommodated to the particular features of the real event. In other words, real events turn into objects of knowing only through the closing of the circle.

Nevertheless, in all the cases I have presented, it is possible to observe that the subjects with no great difficulty described work-related problem situations through the presentation of explicit and well-structured steps for solving the situations. I find that the oral descriptions given by the subjects constitute evidence of the cognitive processes involved when solving problem situations.

Therefore, I emphasize that the information obtained from the subjects, as propositions and procedures, cannot be defined only in terms of what is observable, rather in terms of what the subjects believe they have observed (Piaget 1975/85, 37). Instead, if one remains tied to the observable activity of the subjects, one could erroneously conclude that there is no systematic application of explicit steps when solving problems in everyday settings, such as in the workplace. On this point, clinical-critical interviews have proved useful to capture this aspect.

b) Results

In relation to the interpretation I have presented about the constituents of a task-oriented problem situation, what is still lacking is the clear identification of the cultural variations from case to case, in terms of the intervening culturally-developed systems of signs. That is, I expect to have shown with the cases dealt with that there are constraints under which the interactive process of solving should be seen. These constraints between problem solver, social context and OES do appear in different work-related tasks and settings as constituents to consider in problem design.

In this respect information available in the setting and systems of signs proper to the setting should be taken into consideration. Nunes (1992, 450) has pointed out that higher mental functions involve both invariants, which are related to the principles of the activity itself, and cultural variations, which have to do with the culturally developed systems of signs used in carrying out the activity. This reason calls us to focus on the interplay between invariants and variations when adults are engaged in solving problems.

This assertion is perfectly consistent with interpretations made from Piagetian theory about the influence and contributions of the environment in cognitive development (Inhelder & Sinclair & Bovet 1974, 267-270). I interpret the invariants referring to the activity itself as the universal feature of the process of knowledge constitution. Avoiding maturationist interpretations, it is necessary to stress that cultural variations may result in variations in the speed and direction of development, even though the essential formative process remains invariable.

c) Further research

I would sum up my position by stressing the need for developing further research on the interplay of the three constituents I have presented, characterizing task-oriented problem situations for the purpose of educational design. This should be directed to take into account to what degree each of these elements constrains the successful procedure and particularly success in the situation.

I understand it is crucial to examine both the actions required for developing the task and the characteristics of the final product. Attention to cultural variations that constrain the successful procedure moving from one setting to another should be considered, that is, how culturally-developed systems of values and signs influence the formulation and evaluation of task-oriented problem situations.

Routinization processes should be focused on by examining the relation between resolution of conflicts and routines. In this sense, the stability and changes in routinized process need explanation. I see that general and particular rules constituting routines may help to address routine formation from the cognitive point of view.
This is related to the process of transition between the break of the routine and the subject's acceptance. The idea of task-commitment, task-rejection and task-ignorance (Hautamäki 1995) should be addressed in relation to work routines particularly stability and breaks in the routine.

Finally, I would like to emphasize the necessity and challenge to unite theoretical and practical efforts, from partial results such as the ones I have presented, in order to face the discontinuity between everyday situations at work and organized educational practices, in other words, between natural ways of performing and educational design.

REFERENCES

Argumedo, A. 1982. Qué es la Educación Popular? In *Revista Latinoamericana de Estudios de Educativos*. Vol. XV, 3, 127-137.

Barquera, H. 1982. Las principales propuestas pedagógicas en América Latina. (13-49) In *Investigación y evaluación de experiencias de innovación en educación de adultos*. México. Centro de Estudios Educativos.

Barreiro, J. 1974. Educación Popular y Proceso de Concientización. Buenos Aires. Siglo XXI.

Beisiegel, C. 1979. Cultura do povo e educacao populares. (79-92) In *Revista da Facultade de Educacao da USP, Vol 5, Nos. 1 y 2.*

Bessot, A. & Deprez, S. & Eberhard, M. & Gomas, B. 1993. Un approche didactique de la lecture de graphismes thechniques en formation professionnelle de base aux métiers du batiment. In Espaces graphiques et praphismes d'espaces. Ministère de la Recherche et de la Technologie dans le cadre du programme Formation et Apprentissage des adultes peu qualifés.

Biggs, J. 1992a. Modes of learning, forms of knowing, and ways of schooling. In *Neo-Piagetian theories of cognitive development*. (31-51) Edited by Demetriou, A. & Shayer, M. & Efklides, A. 1992. London. Routledge.

Biggs, J. 1992b. Returning to school. Review and discussion. In *Neo-Piagetian theories of cognitive development.* (277-94) Edited by Demetriou, A. & Shayer, M. & Efklides, A. 1992. London. Routledge.

Bohm, D. & Peat, D. 1987. Science, Order & Creativity. London. Routledge.

Bourdieu, P. & Passeron, J. 1970/77. Reproduction in Education, Society and Culture. Translated from French by Richard Nice.In *Studies in Social and Educational Change.* Vol. 5, London. SAGE Publications.

Boyle, D. 1983. The mith of Piaget´s contribution to education. (69-83) In *Jean Piaget: An interdisciplinary critique.* Edited by Modgil, S. & Modgil, C. & Brown, G. 1983. London. Routledge & Kegan Paul.

Bright, B. 1989. Theory and Practice in the Study of Adult Education. The Epistemological Debate. London. Routledge.

Brotherton, C. 1991. New developments in research on adult cognition. Department of Education. University of Nottingham.

Carraher, T. 1986. Aprender Pensando. Contribucoes da Psicologia Cognitiva para a Educacao. Petropolis, Brasil. Editora Vozes.

Carraher, T. & Carraher, D. & Schliemann, A. 1986. Cultura, Escola, Ideologia e Cognicao: continuando um debate." (78-85) In *Caderno de Pesquisa (57).* Sao Paulo.

Carraher, T. & Carraher, D. & Schliemann, A. 1988. Na Vida Dez, Na Escola Zero. Sao Paulo. Cortez Editora.

Carretero, M. & García Madruga, J. 1984. Lecturas de Psicología del Pensamiento. Razonamiento, solución de problemas y desarrollo cognitivo. Madrid. Alianza Editorial.

Castillo, A. & Latapí, P. 1981. La Educación de Adultos en América Latina. Buenos Aires, Editorial Siglo XXI.

Castorina, J. & Lenzi, A & Fernandez, S. 1984. Psicología Genética: aspectos metodológicos e implicaciones pedagógicas. Buenos Aires. Editorial Miño & Dávila.

Castorina, J. 1984. Psicogénesis e Ilusiones Pedagógicas. In *Psicología Genética.* Buenos Aires. Editorial Miño & Dávila.

Castorina, J. 1989. La Posición de los Objetos. In *Problemas de Psicología Genética.* Buenos Aires. Editorial Miño & Dávila.

Castorina, J. 1992. Constructivismo y Escuela. Cuadernos de la Fundación Escuela de PsicoPedagogía Clínica. Buenos Aires. EPPEC.

Castorina, J. 1993. Problemas epistemológicos de las teorías de aprendizaje en su transferencia a la educación. Mimeo (Unpublished).

Ceci, S. & Roazzi, A. 1994. The effects of context on cognition: postcards from Brazil. In *Mind in Context. Interactionist Perspectives on Human Intelligence.* Edited by Stenberg, J. & Wagner, R. Cambridge University Press.

Chaparro, F. 1986. Alternativas de la educación básica para adultos. (10-11) In *Boletín: Proyecto Principal de Educación en América Latina y Caribe.* Oficina Regional de Educación para América Latina y Caribe. México. UNESCO.

Charnay, R. 1987. Aprender (por medio de) la Resolución de Problemas. I.N.R.P. France. Unpublished. Translated into Spanish by Santiago Ruiz. IPEA. Universidad Nacional del Comahue. Argentina.

Coben, D. 1992. Radical heroes: Gramsci, Freire and the liberal tradition in adult education. PhD Thesis, Faculty of Social Sciences. University of kent.

Cohen, B. 1985. Revolution in Science. London. The Belknap Press of Harvard University Press.

Cole, M & Scribner, S. 1974. Culture and Thought. A psychological introduction. New York. John Wiley & Sons, Inc.

Colinvaux, D. & Dibar Ure, C. 1989. Trabajando con Adultos no alfabetizados: La construcción de la noción de espacio. In *Problemas de Psicología Genética*, by Castorina, et al. Buenos Aires. Miño y Dávila.

Coll, C. 1981. Psicología Genética y Educación. Barcelona. Editorial OIKOS-TAU.

Coll, C. & Marti, E. 1990. Aprendizaje y Desarrollo: la concepción genético cognitiva del aprendizaje. (121-41) In *Desarrollo Psicológico y Educación.* Edited by Coll, C. & Palacios, J. & Marchesi, A. 1990. Madrid. Editorial Alianza Psicología.

Coll, C. & Palacios, J. & Marchesi, A. 1990. Desarrollo Psicológico y Educación. Madrid. Editorial Alianza Psicología.

Comte, A. 1973. Curso de Filosofía Positiva. Primera y segunda lecciones. Translated into Spanish by José Manuel Revuelta from *Cours de philosophie positive*. Buenos Aires. Ediciones Aguilar.

Doise, W. & Mugny, G. 1984. The Social Significance of the Study of Intelligence. In Interaction Series in Experimental Social Psychology. Volume 10. 1984. Edited by Pergamon Press.

Demetriou, A. & Shayer, M. & Efklides, A. 1992 Neo-Piagetian theories of cognitive development. London. Routledge.

De Vega, M. 1985. Resolución de Problemas. (493-514) In *Introducción a la Psicología Cognitiva.* Barcelona.

Eco, U. 1990. Como se hace una tesis. Técnicas y procedimientos de invesigación, estudio y escritura. Translated by Lucía Baranda y Alberto Clalvería Ibañez from *Come si fa una tesi di laurea.* Barcelona. Editorial Gadisa.

Engeström, Y. 1992. Interactive expertise. Studies in Distributed Intelligence. Research Bulletin 83. Department of Education. University of Helsinki, Finland.

Engeström, Y. 1994. Training for change: new approach to instruction and learning in working life. Geneve. International Labour Office.

Ferreiro, E. & Teberosky, A. 1985. Los Sistemas de Escritura en el desarrollo del niño. Buenos Aires. Siglo XXI.

Ferreiro, E. 1986. Procesos de Alfabetización. La Alfabetización en Proceso. México. Centro Editor de América Latina.

Ferreiro, E. 1987. Conceptualizaciones Matemáticas en Adultos no Alfabetizados. México. Centro de Investigación y de Estudios Avanzados del I.P.N.

Frank, A. 1971. Capitalism and Underdevelopment in Latin America. London. Penguin.

Fregona, D. & Villar, M. & Llorente, J. 1988. Adultos in situación escolar: una aproximación a su realidad. Research report. Secretaría de Investigación. Universidad Nacional del Comahue. Argentina.

Freire, P. 1972. Pedagogy of the Oppressed. Translated by Myra Bergman Ramos. London. Penguin Books.

Freire, P. 1974. Education: the practice of freedom. Translated by Myra Bergman Ramos. London. Writers and Readers Cooperative.

Freire, P. 1976. Educación y Cambio. Buenos Aires. Ediciones Búsqueda.

Freire, P. & Frei Beto. 1985. Una Escuela llamada Vida. Buenos Aires. Argentina. Editorial Legasa.

Furth, H. 1969. Piaget and Knowledge. Theoretical Foundations. New Jersey.Prentice-Hall, Inc.

Gajardo, M. 1985. Pesquisa Participante: Propostas e Projectos. In *Repensando a Pesquisa Participante*. Edited by Rodriguez Brandao. Sao Paulo. Edit. Brasiliense.

García, R. & Inhelder, B. & Vonèche, J. 1977/1978. Homenaje a Jean Piaget. Epistemología genética y equilibración. Translated by Fernando Vidal from *Epistémologie génétique et équilibration. Hommage a Jean Piaget*. Buenos Aires. Editorial Huemul.

Giddens, A. 1987/90. La teoría social, hoy. Translated by Jesús Alborés from *Social Theory Today*. México. Alianza Editorial.

Greeno, J. 1980. Problem Solving and Education. In *Issues in Teaching and Research*. Edited by Tuma, D. & Reif, F. 1980. New York. LEA

Gruber, H. & Vonèche, J. 1977. The essential Piaget. London. Routledge & Kegan.

Habermas, J. 1968/82. Conocimiento e Interés. Translated into Spanish from *Erkenntnis und Interesse*. Madrid. Taurus Ediciones.

Harris, M. 1991. Schools, Mathematics and Work. London The Falmer Press.

Hautamäki, J. 1994. Developmental tasks and school learning. In *Ter Laak, J.J.F., (ed) Voronova papers on developmental tasks*. Utrecht Universty Press.

Hautamäki, J. 1995. Task commitment and developmental tasks: a theoretical scene with a case stady in vignettes. Manuscript.

Hautamäki, J. & Kärkkäinen, K. & Räty-Sarho, P. 1995. Adaptative school and Instructional design. 6th. European Conference for Research on Learning and Instruction, August 1995. Nijmegen, Symposium Integrated Instructional Design Technology.

Hernandez, I. 1989. Adult Education: Governmental and Non-governmental action in Latin America. In *Government Roles in Adult Education. International Perspectives*. Edited by Swinbourne & Wellings. Sydney. Grade 88 Inc.

Heller, A. 1987. Sociología de la Vida Cotidiana. 2da.Edición. Translated into Spanish by Yvars & Perez Nadal. Barcelona. Editorial Península.

Heymans, P. 1994. Developmental tasks: A cultural analysis of human development. In *Developmental tasks.* Edited by Laak & Heymans & Podosl'skij. London. Kluwer Academic Publishers.

Inhelder, B. & Sinclair, H. & Bovet, M. 1974. Learning and Development of Cognition. Translated by Wedgwood, S. from *Apprentissage et Structures de la Connaissance.* London Routledge & Kegan Paul Ltd.

Jacob, E. 1992. Culture, Context and Cognition. In *Handbook of Qualitative Research in Education.* London. Edited by Le Compte & Millroy & Preissle. London. Academic Press Inc.

Kahney, H. 1986. Problem Solving. A cognitive approach. Philadelphia. Open University Press.

Karmiloff-Smith, A. 1984. Children´s Problem Solving. In *Advances in Developmental Psychology, Vol. 3.* Hillsdale, New York. L.E.A.

Kitchener, K. & King, P. 1990. The reflective judgment model: Transforming assumptions about knowledge. (159-176) In *"Fostering Critical Reflection in Adulthood.* Mezirow, J. 1990. New York. Jossey-Bass Publishers.

Kitchener, R. 1986. Piaget's Theory of Knowledge. Genetic Epistemology and Scientific Reason. New Haven and London. Yale University Press.

Klimovsky, G. 1994. Las desventuras del conocimiento científico. Una introducción a la epistemología. Buenos Aires. AZ Editora.

Kolb, D. 1993. The process of experiential learning. (139-56) In *Culture and processes of Adult Learning.* Edited by Thorpe, M. & Edwards, R. & Hanson, A. 1993. London. Routledge.

Kontiainen, S. 1991. Use of conceptual models in case studies. Dynamic concept analysis. University of Helsinki. Department of Education. Research Bulletin Nro 78. Helsinki, Finland.

Kreps, D. 1990. Macroeconomic Theory. (18-22) New York. Harvester Wheatsheaf.

Kuhn, T. 1971. La estructura de las revoluciones científicas. Translated into Spanish from *The Structure of the Scientific Revolutions,* by Agustin Contin. México. Fondo de Cultura Económica.

Lakatos, I. 1970. Falsification and the Methodology of Scientific Research Programmes. (91-196) In *Criticism and the Growth of Knowledge*. Edited by Lakatos & Musgrave. Cambridge University Press.

Lave, J. 1988. Cognition in Practice. Mind, mathematics and culture in everyday life. Cambridge University Press.

Lenzi, A. 1985. Modulo II, Catedra de Psicología y Epistemología Genética. Facultad Psicología de la Universidad de Buenos Aires. C.E.P.-UBA.

Lenzi, A. 1989. La teoría Psicogenética de Piaget y sus consecuencias para la enseñanza y el aprendizaje. Facultad de Psicología, Universidad de Buenos Aires. (Unpublished work presented to the concourse of Titular Professor, Cátedra de Psicología y Epistemología Genética.)

Llorente, J. 1991a. Los saberes cotidianos de Adultos Analfabetos. Universidad Nacional del Comahue. Secretaría de Investigación. Argentina.

Llorente, J. 1991b. La Escuela como Institución. In *Adultos in Situación escolar: Una aproximación a su realidad*, by Villar, M. Research Report. Secretaría de Investigación. Universidad Nacional del Comahue. Argentina.

Lloyd, P. 1983. Language and communication: Piaget´s influence. In *Jean Piaget: An interdisciplinary critique.* (27-42) Edited by Modgil, S. & Modgil, C. & Brown, G. 1983. London. Routledge & Kegan Paul.

Lovisolo, H. 1988. La Educación de Adultos Entre Dos Modelos. Universidade Campina, Brasil. (mimeo)

Masingila, J. 1994. Mathematics Practice in Carpet Laying. (430-462) In *Anthropology & Education Quaterly* 25(4). American Anthropological Association.

Mariño, G. 1987. Cómo Opera Matematicamente un Adulto de Sector Popular. Colombia: Dimensión Educativa.

Materi, L. & Alzabé, B. 1991. Educación y Trabajo Productivo en la Posmodernidad. Buenos Aires. La Colmena.

Mendes, C. 1966. Memento dos vivos. A esquerda católica no Brasil. Rio de Janeiro. Tempo Brasileiro.

Mezirow, J. 1981. A Critical Theory of Adult Learning and Education. (3-24) In *Adult Education, Vol.32, Number 1.*

Mezirow, J. & Associates. 1990. Fostering Critical Reflection in Adulthood. New York. Jossey-Bass.

México, declaración de. 1979. Proyecto principal para América Latina y Caribe. (135-148). México. UNESCO.

Modgil, S. 1974. Piagetian Research: a handbook of recent research. Great Britain. NFER Publishing Company Ltd.

Modgil, S. & Modgil, C. 1983. Piaget (1896-1980): the continuing debate. In Jean Piaget: An interdisciplinary critique. (3-11) Edited by Modgil, S. & Modgil, C. & Brown, G. 1983. London. Routledge & Kegan Paul.

Nunes, T. 1992. Cognitive Invariants and Cultural Variation in Mathematical Concepts. (433-453) In *International Journal of Behavioural Development*. 1992, 15 (4).

Nunes, T. & Schliemann, A. & Carraher, D. 1993. Street Mathematics and School Mathematics. Cambridge University Press.

Nuñez Fernandez, M. 1982. Desarrollo Cognitivo del Niño y Enseñanza de las Ciencias Naturales. In *Revista EDUCACION, nro.42*. México. Consejo Nacional Técnico de la Educación.

Ormeño, E. 1989. Adult Education Research: Latin America. (514-17) In *Lifelong Education for Adults. An International Handbook*. Edited by Titmus, C. 1989. Oxford, New York. Pergamon Press.

Paiva, V. 1980. Estado e educacao popular: recolocando o problema. (79-87) In *A questao política da educacao popular*. Edited by Brandao, C. 1980. Sao Paulo. Brasiliense.

Perret Clermont, A. 1980. Social interactions and cognitive development in children. London. Academic Press.

Perret Clermont, A. & Nicolet, M. 1992. Interactuar y Conocer. Desafíos y regulaciones sociales en el desarrollo cognitivo. Translated by Langlois, E. from *Interagir et connaitre. Enjeux et régulations sociales dans le développement cognitif*. Buenos Aires. Miño y Dávila.

Piaget, J. 1936/63. The Origin of Intelligence in Children. Translated by M. Cook. New York: W. Norton.

Piaget, J. 1957/71. The Myth of the Sensorial Origin of Scientific Knowledge. In *Psychology and Epistemology*. Translated by A. Rosin. New York. Viking.

Piaget, J. 1964. Cognitive Development in Children: Development and Learning. Journal of Research in Science Teaching.

Piaget, J. 1964/67. Six psychological Studies. Translated by Tenzer, A. from *Six Etudes de Psychologie*. 1964. New York. Vintage Books Editions.

Piaget, J. 1966. Autobiographie. In Piaget, J. *Werk und Wirkung*, Munich. Kindler. Translated and published in Kitchener, R. 1986 Piaget´s Theory of Knowledge (3). New Haven and London. Yale University Press.

Piaget, J. & Inhelder, B. 1966/69. The Psychology of the Child. Translated by Weaver, H. from *La Psychologie de l'enfant*. 1966. New York. Basic Books Inc.

Piaget, J. 1970/85. Psicología y Epistemología. Translated by Francisco Fernandez Buey from *Psychology et épistémologie*. Barcelona. España: Editorial Planeta de Agostini.

Piaget, J. 1977. The grasp of consciousness. Action and concept in the Young Child. Great Britain. Routledge & Kegan Paul.

Piaget, J. 1977/80. Investigaciones sobre la abstracción reflexionante II. Translated by Alicia Entel from *Recherches sur l'abstraction réfléchissante*. Buenos Aires. Editorial Huemul.

Piaget, J. 1978a. Introducción a la Epistemología Genética. I El Pensamiento matemático. 2da. Edición. Buenos Aires. Paidos.

Piaget, J. 1978b. Success and Understanding. Translated by Pomerans, A. from *Rèussir et comprendre*. Harvard University Press.

Piaget, J. & García, R. 1982. Psicogénesis e Historia de las Ciencias. Mexico. Editorial Siglo XXI.

Piaget, J. 1975/85. The Equilibration of Cognitive Structures. The Central Problem of Intellectual Development. Translated by Terrance Brown from *L'équilibration des structures cognitives.* The University of Chicago Press.

Piaget, J. 1993. Estudios sobre lógica y psicología. Compilation by Delval & Deaño. Barcelona. Atalaya.

Pozo, J. 1989. Teorías Cognitivas del Aprendizaje. Madrid. Editorial Morata.

Puiggrós, A. & José, S. & Balduzzi, J. 1987. Pedagogía de la imaginación para América Latina. Buenos Aires. Editorial Contrapunto.

Reason, P. & Rowan, J. 1981. Human Inquiry: A sourcebook of new paradigm research. New York.

Rockwell, E. & Ezpeleta, J. 1987. La escuela: relato de un proceso de construcción inconcluso. México. D.I.E.

Rogoff, B & Lave, J. 1984. Everyday Cognition. Its development in social context. London. Harvard University Press.

Sants, J. 1983. Piaget's attitudes to education. In Jean Piaget: An interdisciplinary critique. (85-94) Edited by Modgil, S. & Modgil, C. & Brown, G. 1983. London. Routledge & Kegan Paul.

Sarvimäki, A. 1988. Knowledge in Interactive Practice Disciplines. An analysis of knowledge in education and health care. Research Bulletin 68. Department of Education, University of Helsinki. Finland.

Saxe, J. 1991. Culture and Cognitive Development: Studies in Mathematical Understanding. London. LEA, Publishers.

Schmelkes, S. 1980. La investigación sobre educación de adultos in América Latina. Mexico. Ponencia presentada in el Ciclo de Conferencias sobre Educación de Adultos.

Scribner, S. 1983. Mind in Action: A functional approach to thinking. In Laboratory of Comparative Human Cognition, Volume 14, Number 4, 1992. San Diego. University of California.

Scribner, S. & Sachs, P. 1991. Knowledge acquisition at work. IEE Number 2, December, 1991. Institute on Education and the Economy.

Seminario Técnico Regional sobre Alternativas de Educación Básica de Adultos in el marco de la REDALF del Proyecto Principal de Educación de América Latina y Caribe. 1987. Final Document. Venezuela. UNESCO.

Simon, H. 1978. Information-Processing Theory of Human Problem Solving. In *HandBook of Learning and Cognitive Processes. Vol.5. Human Information Processing.* Hillsdale, New Jersey. L.E.A.

Sirvent, M. 1994. Educación de Adultos: investigación y participación. Desafíos y contradicciones. Buenos Aires. Coquena Grupo Editor.

Schliemann, A. 1988. Escolarizacao Formal versus Experiencia Práctica na Resolucao de Problemas. (69-85) In *Na Vida Dez Na Escola Zero.* Brazil. Cortez Editora.

Tennant, M. 1993. Adult Development. (118-138) In *Culture and processes of Adult Learning.* Edited by Thorpe, M. & Edwards, R. & Hanson, A. 1993. London. Routledge.

Usher, R. 1989. Locating adult education in the practical. (65-93) In *Theory and Practice in the Study of Adult Education. The epistemological debate.* Edited by Bright, B. 1989. London. Routledge.

Vergnaud, G. 1981. Quelque orintations théoriques et méthodologiques des recherches francaises en didactique des mathématiques. *Actes du colloque du Groupe International Psychology of Mathematics Education,* Vol. 2, Laboratoire IMAGG, Grenoble.

Vergnaud, G. 1985. Concepts et schèmes dans une théorie opératoire de la représentation. Psychologie Francaise, 30 (3-4), 245-252.

Villar, M. 1991. Adultos en situación escolar: una aproximación a su realidad. Research report. Secretaría de Investigación. Universidad Nacional del Comahue. Argentina.

Vygotsky, L. 1982. Pensamiento y Lenguanje. El problema del lenguaje y el pensamiento del niño en la teoría de Piaget. Translated by Bravo, J. Moscú. Editorial Pedagógica.

Wertsch, J. 1991. Voices of the Mind. A sociocultural approach to mediated action. London. Harvester/Wheatsheaf.

Wolcott, H. 1992. Posturing Qualitative Inquiry. (5-51) In *The Hand Book of Qualitative Research in Education*. Edited by Le Compte, M. & Millroy, W. & Preissle, J. 1992. Academic Press Inc.

Wynia, G. 1990. The politics of Latin American Development. 3rd edition. Cambridge. Cambridge University Press.

Yaroshevsky, M. 1990. A history of psychology. Moscow. Progress Publishers.

APPENDICES

APPENDIX 1: Sample

Exploratory Sample

1.a. Age Group by Sex and School Experience

Age Group	Total Sample	Total		School Experience							
				None		>2 years		2-4 years		4< years	
		M	F	M	F	M	F	M	F	M	F
Total	12	6	6	3		2	2	1	4		
- 20											
21-40	2		2				2				
41-60	9	5	4	2		2		1	4		
60+	1	1		1							

1.b. School Experience by Work Activity

School Experience	Total	Work Activities			
		Rural	Building	Domestic	Others
Total	12	3	2	5	2
None	3	1	1		1
<2 years	4	1	1	2	
2-4 years	5	1		3	1
>4 years					

1.c. School Experience by Place of Origin

School Experience	Total	Place of Origin		
		Rural origin	Suburban origin	Urban origin
Total	12	11		1
No school experience	3	3		
<2 years	4	4		
2-4 years	5	4		1
>4 years				

Final Sample

2.a. Age Group by Sex and School Experience

Age Group	Total Sample	Total		School Experience							
				None		<2 years		2-4 years		>4 years	
		M	F	M	F	M	F	M	F	M	F
Total	21	13	8	1	3	6	3	5	1	1	1
- 20	1	1						1			
21-40	6	2	4	1	1	1	2		1		
41-60	12	8	4		2	4	1	3		1	1
60+	2	2				1		1			

2.b. School Experience by Work Activity

School Experience	Total	Work Activities			
		Rural	Building	Domestic	Others
Total	21	5	8	7	1
None	4		1	3	
<2 years	9	3	3	2	1[82]
2-4 years	6	2	3	1	
>4 years	2		1	1	

2.c. School Experience by Place of Origin

School Experience	Total	Place of Origin		
		Rural origin	Suburban origin	Urban origin
Total	21	17	3	1
No school experience	4	4		
<2 years	9	8	1	
2-4 years	6	3	2	1
>4 years	2	2		

---

[82] She works as a cook in the Municipality.

Total Sample

3.a. Age Group by Sex and School Experience

Age Group	Total Sample	Total		School Experience							
				None		<2 years		2-4 years		>4 years	
		M	F	M	F	M	F	M	F	M	F
Total	33	19	14	4	3	8	5	6	5	1	1
- 20	1	1						1			
21-40	8	2	6	1	1	1	4		1		
41-60	21	13	8	2	2	6	1	4	4	1	1
60+	3	3		1		1		1			

3.b. School Experience by Work Activity

School Experience	Total	Work Activities			
		Rural	Building	Domestic	Others
Total	33	8	10	12	3
None	7	1	2	3	1
<2 years	13	4	4	4	1
2-4 years	11	3	3	4	1
>4 years	2		1	1	

3.c. School Experience by Place of Origin

School Experience	Total	Place of Origin		
		Rural origin	Suburban origin	Urban origin
Total	33	28	3	2
No school experience	7	7		
<2 years	13	12	1	
2-4 years	11	7	2	2
>4 years	2	2		

APPENDIX 2: Work practices

a) Building work

Could you tell me how an octagonal corner is built?

- Making it like that, does it always work for you? Doesn't the wall come out wrong? How do you know that? Do you know any other way of making an octagonal corner? Please, tell me?
- I have been told that sometimes a quadrant is used. Do you know about that? Please, tell me? But if you have to build a wall with an octagonal corner, for example from here until there (big distance), does the quadrant serve equally? And how do you know that the wall doesn't get twisted?
- Could you help me with one doubt I have. The other day I was told about the formula 3, 4, 5 and to tell the truth, I don't understand very well what it is. Do you know it? Could you explain it to me? But, why 3, 4, 5 and not 3, 6, 8? And does that serve equally well for a small or for a big octagonal corner? How do you know that?
- Tell me, how did you learn this formula? How did you learn to use the quadrant? Do all masons know it? And before knowing that, how did you make an octagonal corner? What is the most used method?

Could you tell how concrete is prepared?

Is it always prepared like that? In what cases is it prepared differently? Why? Do you know other ways of preparing it? Please, tell me?
- I was told that generally 1, 3, 3 is used. Why don't you tell me why that is? If you didn't have the mixer, how would you make it? How do you know how much water is needed? Why is it that quantity and not more or less?
- Tell me, if you had to prepare less or more concrete, how would you make it?
- What happens if instead of 1, 3, 3 you put in 1, 5, 3?
- Tell me, once the blend is prepared, what happens with the forge? Do you always have to wait that long? Why?
- Tell me, how did you learn to prepare it in that way? Do all masons know this manner of preparation? And before knowing this manner of preparation, how did you make it? Why did you stop making it in that way? What is the most usual manner of preparation?

BEST COPY AVAILABLE

Why don't you tell me how you make a rough cast?

Preparing the blend in that way, did it ever go wrong for you? Please, tell me about it. Why do you think that happened?
- Is it the same for preparing any kind of rough cast? And why is that? Are fine and rough casts the same? Please, tell me.
- I understand that for the interior rough cast, 1-3 is used. Why is that? Please, tell me? And if you didn't have a bucket, how would you do it?
- Does the interior rough cast contain the same materials as the external rough cast? Why? I understand that for an interior rough cast cement is also used. Why is that? And then, how do you prepare it? I was told that it was 1-1/4-3. Why is that? If you know this way to prepare it, why don't you use it?
- Why does one cast contain cement and the other doesn't?
- Tell me, if instead of 1-3 you use 1-5, what happens? Why? And if you used 2-6, what would happen?
- If you had to prepare a large quantity, how would you do it?
- Tell me, how did you learn to prepare it like that? Do all masons know this manner of preparation? And before knowing this way of preparation, how did you prepare it? Why did you stop making it in that way? What is the most usual way?

Why don't you tell me how you make a level of the foundation?

Why is it necessary to make a level of the foundation? Why do you make a level of the foundation? What do you do with a level out-of-true? And if you don't make it, what might happen? Do you know any tool for levelling? How does it function? If you didn't have that tool, wath would you do? But how do you know that the stakes are all at the same height? Is it the same to make a level of a foundation as to make a level wall? Why? How do you make a level wall?

b) Rural work

How do you prune?

- Why do you prune? How do you know where you have to cut a branch? Are all the branches cut equally? Why? I understand that you have to take the wind into account. Do you know about that? Please, tell me. And where there is no wind, do you still have to prune? If you didn't prune, what would happen? When do you prune? Why? How did you learn to prune? Do all the peons prune the same way? Please, tell me. And why do you prune this way and not another way?

c) Domestic work

Do you make preserves? Why don't you tell us how you prepare them?

Do you always use that quantity of fruit and sugar? If you wanted to make less, how would you make it? What happens if you put the same quantity of sugar to that quantity of fruit? How long do you let it simmer? Why? What happens if you let it simmer less? For example, how many jars do you need for that quantity? Of what size? And if you had only 1/2 kg jars, how many would you need? How did you learn to make it in that way? Do you know other ways of preparing it? Please, tell me. And why do you prepare it in that way and not in another?

Do you knit? Why don't you tell us how you make a pullover?

How do you calculate how much yarn you need? And if the yarn is thicker, do you need the same quantity? How do you know? With fine needles, do you need more or less yarn? Why? How do you know how many stitches you have to put in a sleeve, for example?Is it all equal or does it change? Why is that? And how do you make the back piece? Is it all straight forward? How did you learn to knit? Tell me, do you know any other way of making the back piece or the sleeve? Please, tell me.

d) Problem situations

What is a problem situation?

When you were working, did you ever have any problems? How did you solve them?
What kinds of problems do you think there are at school?
Are the problems at school different from those at work? What differences do you find?
And, what is a problem for you?
How do you solve a problem?
What things do you take into account in solving a problem?

APPENDIX 3: Questions by thematic block

I

- What good is it to be able to read?
- What good is it to be able to write?
- For what do you think school is important?
- Do you find any difference between people who have gone to school and those who haven't? Why don't you tell us?

II

- What are the things you can only learn at school?
- How did you learn to make calculations?

III

- What is more important for you, to be able to read and write or to calculate?

IV

- What is more difficult for you, to calculate mentally or with paper and pencil?
- What do you think is easier, to learn to read or to write?

V

- How do you think one learns at school?
- How do you think one learns at work?
- Tell me the work you learnt to do in the countryside (or in Chile), did it help for working here? Why?

VI

- These things you tell me that you learnt when working, do you forget them or not? Why?
- Do you think the same happens with the things you learn at school? Why?

VII

- Why don't you tell me, when do you face problems in your work?
- And what do you think the problems are at school?
- What is a problem for you?
- What does it mean to solve a problem?
- When is a problem solved?
- Did you ever have a problem at work?
- How did you solve it?

APPENDIX 4: Latest interview

1 - Where did you live as a child?
2 - a) Why don't you tell us why you came to Valle?[81]
  b) Did you always live in this suburb or zone? Please tell me?
3 - a) Tell me, have you been working it for a long time?
  b) Did you always work in your home? Why?
4 - Did you ever go to school? For how long?
5 - Did you find it important to go to school? Why? What things did you learn?
6 - How do you think one learns at school?
7 - What use is it for you to be able to read?
8 - As you are in construction ...(see Appendix 2)
9 - What is a problem for you? (see Appendix 2)
10 - And how does one learn at work?
11 - What use would it be for you to be able to write?
12 - What do you think is easier: to learn to read or to learn to write?
13 - How did you learn to do arithmetic?
14 - Tell me, what is more difficult for you, to calculate mentally or with a pen and paper?
15 - About things you told me you had learnt at work, do you forget them or not? Why do you think it's like that?
16 - Do you think that the same happens with what you learn at school? Why?
17 - For example, all the things you had learnt when living in the countryside or in Chile, were they of use for you working here? Why?
18 - Do you find any difference between people who have gone to school and those who haven't? Please, tell me.
19 - What are the things you only learn at school?
20 - What is more important: to be able to read and write or to do arithmetic?

---

[81] Refers to the high valley of the river Río Negro, abbreviated from *Alto Valle*, the geographical name.

APPENDIX 5: Adults in the schooling situation (Abstract)

The study focused on the learning processes of adults within the school. The theoretical framework was Piagetian theory. The central aim was to examine the conditions underlying the teaching-learning processes developed in the schooling situation.

The study was conducted in the south of Argentina, Río Negro in the University of Comahue (Villar 1991). Two State schools for adults were observed adopting an ethnographic approach. The observations were complemented by individual as well as group interviews to teachers and students. The adults attending school were illiterates or with little schooling. The ages ranged from 25 to 60 years old and the two groups observed had from 13 to 15 participants.

The analysis of the net of relations taking place in the classroom revealed that the pedagogical process was developed regardless of the student´s knowledge acquired before attending school. School criteria determined the learning processes preventing the use of no-school strategies or students' knowledge.

APPENDIX 6: Interview profiles

EXPLORATORY INTERVIEWS

6.1.a Domestic Work

1.	Interviewee:	Elsa
	Interviewer:	Juan Carlos Llorente & María Haydeé Villar
	Duration:	45 minutes
	Age:	44 years
	Schooling:	Without school experience during childhood. At the present attends a school for adults
	Work situation:	Domestic help
	Place:	Elsa's house
	Main topics:	Work history. Migration from rural area to suburban area. Schooling of the family. Value of reading and writing in her history. Old people cannot learn to read and write. Reading and writing as an agent of change in personal life. School and reading and writing. Mathematics does not appear. Knitting and the application of this learning. Fruit related work.
	Observation:	Elsa was interviewed together with her father. But the interview developed well.
2.	Interviewee:	Blanca
	Interviewer:	Juan Carlos Llorente & María Haydeé Villar
	Duration:	45 minutes (recorded)
	Age:	35 years
	Schooling:	Little schooling during childhood. She avoids answering.
	Work situation:	Domestic help
	Place:	Blanca's house
	Main topics:	Value of the school. Reading and writing. Changes related to knowing how to read. Learning by observing. Work-related learning is never forgotten. Things learned in the school are easily forgotten. The school helps in the correct the calculation of money.
	Observation:	Blanca was interviewed together with her father.
3.	Interviewee:	Margarita
	Interviewer:	Juan Carlos Llorente & María Haydeé Villar
	Duration:	30 minutes (recorded)

Age: 40 years

Schooling: Attended for short periods at a literacy centre. At present attends a State school for adults

Work situation: Housewife

Place: Margarita's house

Main topics: Calculation of salary. Knitting. Self-learning. Rural works. School learning is forgotten. Work related learning is not forgotten. Mathematics is not important, one learns in everyday life. School and reading and writing. The use of money. Differences between literacy centre and State school for adults. Value of the school teacher. Value of the copy book, testimony of learning.

4. Interviewee: Graciela

Interviewer: Juan Carlos Llorente & María Haydeé Villar

Duration: 2 hours and 30 minutes.

Age: 42 years

Schooling: Less than two years during childhood

Work situation: Housewife

Place: Family's house

Main topics: Preserves. Apple and pear jam. Knitting. Conserving of fresh fruits (apples) for six months different recipes. Measures. Grape harvest. Family educational history. Negative value of the school institution.

Observations: The interview was conducted together with her husband. The interviewers visited them twice. The husband always anticipated the answers.

5. Interviewee: Mónica A.

Interviewer: Juan Carlos Llorente & María Haydeé Villar

Duration: 20 minutes

Age: 48 years

Schooling: 4 years during childhood. At present attends a State school for adults

Work situation: Housewife. Works as a domestic help on short contracts

Place: School for adults

Main topics: Difference between learning at school and work. Value of reading and writing in everyday life. Preparation of apple jam. Proportions.

Observations: Mónica was contacted through her teacher. She showed fairly little interest in the interview and refused to answer many questions related to her domestic work.

6.1.b Building work

6. Interviewee: Blanca's father
Interviewer: Juan Carlos Llorente & María Haydeé Villar
Duration: 45 minutes
Age: 71 years
Schooling: Without schooling
Work situation: Without work
Place: Family's house
Main topics: Work history. Building and rural work. Forestry and carpentry. Measures. Varieties of trees. Bureaucratic formalities. Difficulties to understand the content of bureaucratic forms and procedures. Pensions. Reinstatement of social security. Public works (paving). Everything changes from Chile to Argentina. Names of the tools.
Observations: The interview was conducted together with his daughter.

7. Interviewee: Cornelio
Interviewer: Juan Carlos Llorente & María Haydeé Villar
Duration: 25 minutes
Age: 43 years
Schooling: Without schooling during childhood. At present attends the first course of a State school for adults
Work situation: Building worker. Works on contract
Place: Cornelio's house
Main topics: (see Chapter 4, example of exploratory interview)

6.1.c Rural Work

8. Interviewee: José
Interviewer: Juan Carlos Llorente
Duration: 2 hours and 30 minutes
Age: 45 years
Schooling: Less than three years during childhood. Some years ago finished the primary cycle in a school for adults.

Work situation: Rural worker. Permanent
Place: Family's house in the farm where he works
Main topics: Conservation of fruits. Differences in pruning. Value in education but not in the school (refers to teachers trade union strike). Relates education to God. The bible with reading and writing. Relates schooled people to money. Good works are urban works. Problems are solved with words (with education one speaks better). Intelligence and everyday activities. Measures and proportions. Different kind of plantations related to production. For working experience teaches, formal education does not help.
Observations: The interview was conducted simultaneously with his wife. José talked a lot about education, schooled people, the church and political problems. His employer was at that moment a top level authority in education in the country.

9. Interviewee: Arnoldo
Interviewer: Juan Carlos Llorente
Duration: 1 hour and 15 minutes
Age: 45 years
Schooling: Less than two years during the childhood
Work situation: Rural worker. Permanent job
Place: Workplace
Main topics: Educational history of the family. Work history. Calculation of salary. System of measures. Relates school just with reading and writing. Self-learning of basic calculations. Mental calculation and written calculations. School learning is forgotten. Salaries and proportionality. Difference between works in Chile and Argentina. Practice, learning, productivity. Learning by doing differs from learning by studying. Difficult to learn during adulthood. Usefulness of reading for everyday life. Bureaucratic formalities. Forestry related activities. Proportions related to the use of pesticides. Difference between school and work, the role of teachers. Weight measures. Pruning. Building-for-himself.

10. Interviewee: Roberto
Interviewer: Juan Carlos Llorente & María Haydeé Villar
Duration: 20 minutes
Age: 30 years
Schooling: 4 years during the childhood

Work situation: Rural worker. Works on contract
Place: Family's house
Main topics: No interest in continuing studies. Negative image of the primary school during his childhood. Learning by doing at work. Learning by studying.
Observations: The interview with Roberto was not pre-arranged. He came into his parents' house as they were being interviewed.

6.1.d Other work

11. Interviewee: Niculeo
Interviewer: Juan Carlos Llorente
Duration: 25 minutes
Age: 41 years
Schooling: 3 years during the childhood. Attends a school for adults
Work situation: Unemployed. Works on contracts in rural and building work
Place: School
Main topics: Personal and family educational history. The reason for attending school is reading and writing. Calculations are learned in everyday life. Problems in school are difficult.

Observations: Niculeo was contacted through his teacher. He was not willing to be interviewed.

12. Interviewee: Leiva
Interviewer: Juan Carlos Llorente & María Haydeé Villar
Duration: 45 minutes
Age: 60 years
Schooling: Without schooling
Work situation: Works in a factory of food.
Place: Leiva's family house
Main topics: Moving from countryside to urban centres. Work history. Rural work-related activities. Forestry. Description of the process from the forest to the factory. Differences from Chile to Argentina in developing the same work. Relearning. No reason to attend school. Difficulties in fruit harvest. Different kinds of task in the factory.
Observation: The interview was conducted simultaneously with that of his daughter.

6.2 LATEST INTERVIEWS

6.2.a Domestic work

1. Interviewee: Teresa C.
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 35 minutes
Age: 28 Years
Schooling: 1 year during childhood - 3 months in school for adults
Work situation: Housewife. Occasionally works as a domestic help
Place: Teresa's house
Main topics: Preparation of jam. Differences in proportions according to the kind of fruit. Difference and similarities between school and work problems. In the school teacher's explanations are essential to solve a problem. At work one does it alone.

2. Interviewee: Rosa
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 17 minutes
Age: 42 years
Schooling: Without schooling
Work situation: Domestic help.
Place: Rosa's house. It was not possible to arrange the interview in the house of the employer.
Main topics: Preparation of jam. Proportions. Changes the quantity of water to get more or less quantity of jam.
Observations: Rosa was very nervous during the interview and cried in some moments.

3. Interviewee: Antonia
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 35 minutes
Age: 55 years
Schooling: 4 years during the childhood
Work situation: Housewife
Place: Antonia's house
Main topics: Weaving. Measures related to the thickness of the wool. Sizes and problems. Problem solving: trial-error, disarming.

4. Interviewee: Mónica
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 30 minutes
Age: 27 years
Schooling: Less than two years during the childhood.
Work situation: Domestic help
Place: Mónica's house
Main topics: Preparation of jam. (see Chapter 7, case 8)

5. Interviewee: María Antonia
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 40 minutes
Age: 33 years
Schooling: Without schooling
Work situation: Housewife
Place: María Antonia's house
Main topics: Knitting. (see Chapter 6, case 4)

6. Interviewee: Herminia
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 45 minutes
Age: 54 years
Schooling: Without schooling
Work situation: Domestic help
Place: Employer's house
Main topics: Knitting. Relations between weight of wool and sizes. She uses when knitting things learned when shopping in calculating money. She does not identify problems at work.
Observations: María Antonia was contacted through the employer and this situation did not help Antonia to speak freely about problems. She withdrew when I mentioned the word problems.

7. Interviewee: Teresa
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 30 minutes
Age: 38 years
Schooling: About 4 years during childhood

Work situation: Housewife
Place: Teresa's house
Main topics: Knitting. Differences in sizes according with the thickness of the wool. Problems come about when you are learning. Afterwards it is rare. Knitting one can unpick.
Observations: All members of the family were present during the interview because the house has one room. They did not intervene. Teresa enjoyed showing what she knew.

6.2.b Building work

8. Interviewee: Clemente
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 30 minutes
Age: 37 years
Schooling: 2 years during childhood
Work situation: Building worker. Works on contracts
Place: Workplace.
Main topics: (see Chapter 6, case 2)

9. Interviewee: Fabio
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 30 minutes
Age: 20 years
Schooling: Until 4th grade
Work situation: Building worker. Works on contract
Place: Workplace
Main topics: (see Chapter 6, case 6)

10. Interviewee: Lorenzo
Interviewer: Juan Carlos Llorente & María Haydeé Villar
Duration: 30 minutes
Age: 49 years
Schooling: Two years during childhood
Work situation: Building worker. Works on contract
Place: Workplace
Main topics: (see Chapter 7, case 9)

11. Interviewee: Amado
Interviewer: Juan Carlos Llorente & María Haydeé Villar
Duration: 30 minutes
Age: 67 years
Schooling: 3 years during childhood
Work situation: Building worker. Permanent job
Place: Workplace
Main topics: (see Chapter 6, case 3)

12. Interviewee: Fermín
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 35 minutes
Age: 52 years
Schooling: 3 years during childhood
Work situation: Building worker. Works on contract
Place: Workplace
Main topics: He did not know the use of 3-4-5. Level of a foundation. Preparation of concrete. Proportions. Rough-cast preparation. Search of information. At work problems comes about but not when working in his house.
Observations: There was problems with the recording of the interview because the place was too noisy.

13. Interviewee: José N.
Interviewer: Juan Carlos Llorente & María Haydeé Villar
Duration: 40 minutes (only 20 minutes recorded)
Age: 50 years
Schooling: José tells that he attended school 5 years during childhood but the employer tells he does not read and write.
Work situation: Building worker. Permanent job
Place: Workplace
Main topics: He uses the formula 6-8-10 to find the square. He explains that is the same the use of 3-4-5. He does not have confidence in the use of iron square set. The formula is always exact. To solve a problem one needs stepback from the situation and think it over. Problems in the school are limited by, at work one takes the problem home until one can solve it.

14. Interviewee: Feliciano
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 50 minutes
Age: 36 years
Schooling: Without schooling
Work situation: Building worker and rural worker. Works on contract
Place: Feliciano's house
Main topics: (see Chapter 6, case 5)
Observations: Feliciano was interviewed about pruning, preparation of concrete, rough-cast preparation and foundations of a house. He does not use the formula 3-4-5 but an iron set square.

15. Interviewee: Manuel
Interviewer: Juan Carlos Llorente & María Haydeé Villar
Duration: 60 minutes
Age: 45 years
Schooling: Without schooling
Work situation: Building worker and rural worker.
Place: Workplace
Main topics: Foundation of a house. Use of the formula 3-4-5. Preparation of concrete. Proportions. Use of pesticides. Proportions.
Observations: Problems with the recording of the interview, most of the information was written down and afterwards completed with the information tape-recorded.

6.2.c Rural work

16. Interviewee: Gilberto
Interviewer: Juan Carlos Llorente & María Haydeé Villar
Duration: 30 minutes
Age: 58 years
Schooling: Two years during childhood. One year attended a school for adults.
Work situation: Rural worker. Permanent job
Place: Workplace
Main topics: Pruning. Winds, time and distance between fruit trees. Relation between quantity of fruits and quality of fruit.

Every cut in a branch requires especial decision. Employers requirements. Different kinds of controls. He does not identify differences in pruning apples or cherries. Problems are related to the requirements of the foreman.

17. Interviewee: Solorza
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 25 minutes
Age: 60 years
Schooling: 2 years during childhood
Work situation: Rural worker. Permanent job
Place: Workplace
Main topics: (see Chapter 6, case 7)

18. Interviewee: Bernardo
Interviewer: Juan Carlos Llorente
Duration: 60 minutes
Age: 44 years
Schooling: 4 years during childhood
Work situation: Rural worker. Permanent job
Place: Workplace
Main topics: (see Chapter 5, case 1)

19. Interviewee: José V.
Interviewer: Juan Carlos Llorente & María Inés Salgado
Duration: 30 minutes
Age: 43 years
Schooling: 4 years during childhood
Work situation: Rural worker. Permanent job
Place: Workplace
Main topics: Pruning. He presents pruning as vital for the plant and explains the vital cycle of the plant. Huge knowledge of chemical processes and intervening variables. Winds, light, quality desired. Relation between pruning and maintenance task-related activities like cure and harvesting. Problem solving related to the employer's requirements.

20.	Interviewee:	Francisco
	Interviewer:	Juan Carlos Llorente
	Duration:	20 minutes
	Age:	43 years
	Schooling:	4 years during childhood
	Work situation:	Rural worker. Permanent job
	Place:	Workplace
	Main topics:	Little experience in pruning. Winds, sun protection and quality of the fruits. When problems come about is the foreman who indicates the solution but he identifies the problems.

6.2.d Other work

21.	Interviewee:	Dina
	Interviewer:	Juan Carlos Llorente & María Inés Salgado
	Duration:	27 minutes
	Age:	51 years
	Schooling:	Attending the first course in a school for adults
	Work situation:	Cook. Permanent job in the municipality
	Place:	School for adults where she attends the first course
	Main topics:	Preparation of jam. Proportions with relation to different varieties of fruits. Time of simmering and characteristics of the product. When asked about problems she refused to talk about the present job and referred to other activities. Working in domestic help the solutions are always related to employer's requirements.

Research Bulletin
Department of Education, University of Helsinki

N:o 60 (1982) Erkki A. Niskanen & al.: Research Project on Educational Aims. 105 pp.

N:o 61 (1983) Anna-Liisa Leino & Arja Puurula: Admission to Teacher Education and Two Cognitive Styles. 54 pp.

N:o 62 (1984) Karl Bruhn: The Helsinki Test. The Inkblots and Using the Test. 49 pp.

N:o 63 (1984) Lyyli Ronkonen: Realization of Didactic Principles in Foreign Language Teaching in Soviet Schools. 30 pp.

N:o 64 (1986) Vello Sermat: An Exploration of the Interpersonal Relationships, Health-Related Behavior and Mental Health of Finnish University Students. 29 pp.

N:o 65 (1987) Hannele Niemi: The Meaning of Life among Secondary School Pupils. A Theoretical Framework and Some Initial Results. 81 pp.

N:o 66 (1987) Vesa A. Niskanen: Some Principal Results of the Studies Carried out in the Research Project on Instructional Material. 27 pp.

N:o 67 (1988) Kaarina Yli-Renko: Assessing Foreign Language Training Needs of Adults. A case study from Finland. 90 pp.

N:o 68 (1988) Anneli Sarvimäki: Knowledge in Interactive Practice Disciplines. An analysis of knowledge in education and health care. 276 pp.

x N:o 69 (1988) Kaarina Yli-Renko: Intercultural Communications as an Aim of English Language Teaching. 45 pp.

N:o 70 (1989) Seppo Kontiainen: Integrating Information in Conceptual Models. Use of an information structure in building conceptual models for behavioural studies. 59 pp.

N:o 71 (1989) Jarkko Leino: Theoretical Bacground and Development of Instructional Materials. 25 pp.

x N:o 72 (1989) Anna-Liisa Leino, Jarkko Leino and Juha P. Lindstedt: A Study of Learning Styles. 68 pp.

N:o 73 (1990) Irene Kristiansen: Nonverbal Intelligence and Foreign Language Learning. 164 pp.

N:o 74 (1990) Tapio Puolimatka: Pluralism and Education in Values. 31 pp.

N:o 75 (1990) Erkki A. Niskanen: Personality as an Educational Phenomenon. 44 pp.

N:o 76 (1990) Vesa A. Niskanen: Describing Personality Utilizing the Theory of Fuzzy Systems. 16 pp.

N:o 77 (1991) Raimo Laasonen: Modeling System Operators Affecting the Information Organizer of an Individual. 104 pp.

N:o 78 (1991) Seppo Kontiainen: Use of Conceptual Models in Case Studies. Dynamic Concept Analysis. Applications in collaboration with Klaus Helkama, Peter Herriot, John Hobrough, Jyri Manninen, John Roscoe and Malcolm Tight. 237 pp.

N:o 79 (1991) Jarkko Leino: Dynamic Knowledge in School. An Action Research on Instructional Development with the Aid of Microcomputers. 116 pp.

N:o 80 (1991) Raimo Laasonen: Self-Identification of Personality in Social Environment. 20 pp.

N:o 81 (1992) Pertti Yli-Luoma: Predictors of Critical Thinking Abilities. A Rasch-Model Approach. 142 pp.

N:o 82 (1992) Irene Kristiansen: Foreign Language Learning and Nonlearning. 189 pp.

N:o 83 (1992) Yrjö Engeström: Interactive Expertise: Studies in Distributed Working Intelligence. 105 pp.

N:o 84 (1993) Anna-Liisa Leino-Margareth Drakenberg: Metaphor. An Educational Perspective. 70 pp.

N:o 85 (1993) Elina Lahelma: Policies of Gender and Equal Oppurtunities in Curriculum Development: Discussing the Situation in Finland and Britain. 49 pp.

N:o 86 (1994) Lyyli Ronkonen and Igor Skripjuk: The Problem of Personality in Soviet and Russian Pedagogics. Research Project Personality as an Educational Phenomenon by Professor Erkki A. Niskanen. 44 pp.

N:o 87 (1995) Paula Kyrö: The Management Consulting Industry Described by Using the Concept of "Profession". 304 pp.

N:o 88 (1995) Timo Toiviainen: The Early Contribution of Adult Education to the European Unification Process: The Genesis of the European Bureau of Adult Education and "Meeting Europe" Courses, 1950-1970. 219 pp.

N:o 89 (1995) Satya Mehndiratta Klason: Social Network and Self Conception of Elderly People. 246 pp.

N:o 90 (1996) Editors: Donald Sharpes & Anna-Liisa Leino: The Dynamic Concept of Curriculum. Invited papers to honour the memory of Paul Hellgren. 143 pp.

N:o 91 (1995) Margareth Drakenberg: Compulsory School Development in Sweden. A three-dimensional view.

N:o 92 (1996) Juan Carlos Llorente: Problem Solving and Constitution of Knowledge at Work. 275 pp.

x) Out of print.

Design: Klaus Winqvist

ISBN 951-45-7278-5
ISSN 0359-5749
.Hakapaino Oy
Helsinki 1996

BEST COPY AVAILABLE